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REPORT

OF THE

COMMITTEE OF MASTER SHIPWRIGHTS

ON THE

CONSTRUCTION OF SHIPS OF WAR;

WITH THE

OBSERVATIONS OF THE SURVEYOR OF THE NAVY

THEREON:

ALSO,

REMARKS ON THE OBSERVATIONS OF THE SURVEYOR

BY THE

MASTER SHIPWRIGHTS.

PEABODY MUSEUM OF SALEM

WITH TABLES AND PLANS.

LONDON:
PRINTED BY W. CLOWES AND SONS, 14, CHARING CROSS,
FOR HER MAJESTY'S STATIONERY OFFICE.

1845.

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SHIPWRIGHTS' REPORT.

Surveyor's Observations in Margin, and other Documents from him appended.

Woolwich Yard, April 13th, 1842.

Sir,

By Admiralty order dated 23rd December, 1841, we were directed to assemble in Committee, in this Yard, on the 3rd January last, "to take into consideration the suggestions set forth in a letter from Mr. Blake, the Master Shipwright of Her Majesty's Dock Yard at Portsmouth, and generally the mode of strengthening Her Majesty's ships of war in their construction, having reference to the complaints recently made of the weakness of the 'Britannia' and other ships, and to report to their Lordships, whether the suggestions in the said letter, or any other improvements, can be recommended by us, by which the frames of the ships can be materially strengthened, or by which the placing of the guns in the bows and sterns may give a greater power of attack and defence, without interfering with their powers of sailing against a head sea;" also, to regulate their forms above the load water line, so as to "afford the best possible means of offence and defence at every point, preserving at the same time the utmost practicable strength to each and every part."

Surveyor.

I beg to refer to my remarks on this subject, dated April 5th last,—I consider that doing away with the quarter port, on the point of impunity, is a great sacrifice.

The Chatham Officer's Report, of the 5th May, proves that the defects complained of in the frame of the "Boscawen," principally arose from the improper mode adopted by the Woolwich Officers, as that defect did not exist in the "Cumberland."

The models of the "Boscawen's" stern as altered by the Committee, and the "Cumberland's," are ready for inspection.

The Committee proceeded to examine the stern of Her Majesty's ship "Boscawen," with a view to ascertain the efficiency of the manner in which the timbers of her stern were disposed, which they found to be weak, and reported accordingly on the 15th January (see Appendix No. 1.) They were consequently directed by Admiralty order of the 18th of that month, to forward a statement of the expense of the alterations they had proposed; they also, on the 19th, received your directions to take into their consideration "the efficiency of the stern for fighting her guns, as well as for strength," on which they reported accordingly on the 1st February, that "from the position of the right aft ports on the lower deck, the muzzles of the guns could not be run out sufficiently far by about two feet six inches, nor

I consider the Committee's stern to have serious faults, which do not exist in the "Cumberland's," and am prepared to prove them.

W. S.

Surveyor.

The "Britannia" is fastened upon Sir Robert Sepping's principle, and similar to the greater part of the line-of-battle ships in the Navy; her fastenings had shrunk, and merely required what is termed "furring" or wedging up.

W. S.

Surveyor.

This is at present the practice.

W. S.

those of the quarter ports of the same deck by about six inches" (see Appendix 2). They were then desired to state, "whether they had merely considered the best mode of giving efficiency to her present stern, or whether they had considered that by taking it down altogether, it might not be made thoroughly efficient, both as regards strength and fighting her guns;" to which they replied on the same day, "that they had entirely confined their views to the purpose of rendering her present stern as efficient as possible, not considering that they were empowered to go the length of proposing a new one, which would be the only means of rendering the ship thoroughly effective." For this purpose they promised to forward drawings, which were furnished accordingly on the 21st March, by which plan all the requisite strength will be given, and she will be enabled to fight eleven guns right aft in a line with the keel, with the proper distance between each, and the whole will cross fire with each other; besides these, three other guns can be fired from the round-house, if necessary.

The Committee, with reference to the complaints made of the weakness of the "Britannia," after hearing the statement of the three Members who had surveyed her in November last, and carefully considering the manner in which she was built, were satisfied that the complaints made were unfounded, and that she exhibited no weakness which would have disqualified her from completing her period of service, without being sent home.

On proceeding to take into consideration the general mode of strengthening Her Majesty's ships of war in their construction, the Committee have had in view the great difficulty generally experienced in procuring large timber, its expense, its great liability to decay from being overgrown, and its weakness from being in many instances grain cut, and have therefore endeavoured, as far as possible, to meet these difficulties, and at the same time add strength to the structure: they have also endeavoured, whilst giving a firm combination to the whole, to make the several parts relatively such, that, in the event of repairs being required, they may always be effected with the least expense and the greatest possible dispatch; with these objects in view, they therefore submit the following recommendations, viz.:—

That the keels be invariably put together with flat scarphs; that the length of each scarph be in all cases double the room and space, so as to have two bolts in each through the floors and keelson, and be well clenched on a ring at each end; that they be of the dimensions heretofore prescribed; that the rising wood be sided three inches more than the keel; that the rabbet in the keel be within

Surveyor. I approve of this, as it will assist the conversion. W. S.	two inches of the upper edge; that the frame be rendered quite water-tight, in the event of the keel being carried away; and that stepping and ekeing pieces be introduced to the timbers, floors, and deadwood, properly secured to the deadwood, and coaked to the timbers, as a substitute for chocks, as per Drawings 1, 2, 3.
Surveyor. I approve of this suggestion. W. S.	That to obviate the difficulty frequently found of obtaining a stern post of sufficient length, a curved timber be introduced at the after end of the keel and stern post, with flat scarphs instead of mortices and tenons in the post and keel, as described by the Drawings 1, 2, and 3.
Surveyor. This is at present the general practice. W. S.	That the stem and apron, as at present formed with a rabbet in the middle of the stem at the upper part, breaking in with the rabbet of the keel at the lower end, as well as the deadwood, be continued; and that the lower end of the stem be scarphed to the keel with a flat scarph, instead of boxing.
Surveyor. This is a subject for the Master Shipwright to exercise his discretion upon, to meet the store of timber in conversion. W. S.	That the keelson should as usual be scarphed with flat scarphs, bringing on anchor-stock pieces, where it may be required, for the conversion of the timber; in which case, the lip is to be one fourth the depth of the keelson, and let in one-fourth of the thickness of the lip; circular coaks to be introduced in the seating and scarphs as usual: that it extend aft, to eight or ten feet abaft the aftermost floor, at which place it may be reduced to two-thirds of its depth; and that the length of each scarph be, in all cases, double the room and space, so as to have two bolts in each scarph through the floors and keel, and be well clenched on a ring at each end. That the stemson should run up as high as possible, and not abut under the gun-deck hook; to allow of which, an anchor-stock piece may be applied, to connect the lower end of the stemson with the fore-end of the keelson, as shewn in the Drawings 1, 2, and 3. That it would be advantageous to the service to allow a greater latitude for the selection of timber for floors, for which purpose drawings of several approved plans are forwarded, so that the timber in the several Dock Yards may always be most advantageously converted.
Surveyor. I am of opinion that the shift of frame adopted in the service is superior to this recommendation and I am borne out in that opinion by a report of Mr. Hawkes, dated November 30th, 1833, wherein he compares the frames of the "Clarence" and "Vanguard," which report is sent herewith (see A). W. S.	That whilst it is essential to ensure the requisite degree of strength in the formation of frames, it would also be advantageous to the service to allow a greater latitude in the selection of timbers, since there would then be afforded an opportunity of appropriating the least expensive timber, without subjecting the frame to any defect, stipulating merely, that as a minimum, the timbers of ships of the line and large frigates, should have six feet shift, and one timber between, and that in smaller

ships the minimum shift should be five feet, having the length reduced forward and aft about one foot; but in order to give a greater degree of strength in ships of the line, to that part of the frame most acted upon, the two lengths of timber next below the gun-deck lower sills be somewhat lengthened, and more firmly combined, as shewn in the different drawings; and that in combining the several timbers of the frame, square heads and heels, with circular coaks in the ends, be discontinued; but where it is required for increased strength to dowel the timbers side by side, it will be necessary to have the heads united by angular bills, and wherever scarphs are required, they should be made sideways. The whole of the timbers to be united in frames, and each over-lapping part, where the shift is not more than six feet, to have a frame-bolt about the siding of the timber from each end, and when the shift exceeds six feet, one additional bolt.

That the fillings in the openings between the timbers extend so high up, as that a current of air may pass under the strakes below the orlop clamps; that the whole of the fillings be solid, and three inches within the surface inside, except in the flat of the ship, where water is likely to lodge, in which places they should be flush with the inner side of the timbers; that the water-courses be cut out of the timber strakes, keelsons, or other obstructions, and the fillings be driven in with felt, and afterwards caulked.

Surveyor.

These observations do not refer to the mode of filling adopted generally, on the 21st January and the 10th September, 1833, when a section, after the favourable report of the greater number of the Dock Yards, was generally promulgated. See papers herewith (B).

W. S.

That in timbering the bows and sterns, the same principle be carried out, viz., that there be in all cases, one timber between two butts; that not less than four feet six inches shift be kept up; and that as few timbers as possible should snape, obviating the necessity of snaping by giving side rounds.

Surveyor.

This shift is adopted in the new ships.

W. S.

That the only alterations they deem necessary to make in the scantling of the timbers is, that the moulding of three and two-decked ships be increased to seven inches at the gunwale, and the same at the quarter-deck and forecastle, fore and aft; and that for large frigates to six and a half inches, in the the same position.

Surveyor.

I recommend this suggestion for general adoption.

W. S.

That the scarphs of large beams be increased to twelve feet in length, and those for smaller ones to eleven feet; and that instead of letting the lips in flush, as lately introduced and now in practice, they be of the usual thickness, and let one and a quarter inch only into the beam, except those in wake of the capstan, where it is necessary occasionally to remove the pillars from working it, and in such situations where it is inconvenient to place pillars, in which they recommend that the lips be let in fair, and carved or arched plates be let in flush with the sides, with an up and down lip bolt, as usual, and that the scarphs be dowelled and bolted.

Surveyor.

I feel convinced, from full experience, that the mode adopted in November 1832, is far superior to any other mode of scarphing beams, both with regard to strength and economy. See Report sent herewith (C).

Surveyor.

Of course they would be introduced, if not detrimental to the stowage of the hold.

W. S.

Surveyor.

I cannot recommend their being so close. I consider from 16 to 20 inches quite sufficient. I would prefer thicker deck plank.

W. S.

Surveyor.

I consider the forked knees very superior in point of strength.

W. S.

Surveyor.

I am opposed to this suggestion, as it would add much to the smiths' work without an equivalent; for the fabric, I am convinced, would be stronger if the riders, crutches, hooks, &c., were let into the frame.

W. S.

Surveyor.

This has been long the practice in new ships, and should be continued generally.

W. S.

Surveyor.

I am strongly opposed to the use of treenails; bolt nails are much superior, and great improvement would be accomplished if they were general.

No good shipwright would fasten the plank as herein alluded to.

W. S.

That in the event of any ship of the line exhibiting, at any time, signs of weakness below the orlop, beams of twelve inches square be introduced, five or six feet below that deck, into such situations in the hold, where it can be done without interfering with the stowage.

That the half-beams be of the same sidings as heretofore, when the distance will admit, allowing an opening of not more than sixteen inches, nor less than twelve inches, in which case the sidings may vary accordingly, if required.

That the knees, instead of being forked, as at present, be made with two ears on the up and down arm, and two on the in and out arm, as high up as the side arm, and as near in on the beam arm as may be practicable, as shewn in the Drawings, and that they be of the following weight, viz. :—

	Three-Decked Ships.			Two-Decked Ships.			Large Frigates.		
	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.	Cwt.	qrs.	lbs.
Orlop . .	2	3	0	2	2	14	To be bolted with 2 Diagonal Bolts instead of Knees.		
Lower Deck	3	1	14	3	0	0	1	3	0
Middle . .	2	3	0		—			—	
Upper . .	2	0	0	2	0	0	2	0	0
Quarter and Forecastle	1	1	14	1	1	7	1	1	0

That all riders be of iron, fitted with ears (taking care that they be placed so as to give the best security to the heads and heels of the timbers), upon the plan shewn in the Sketches 4, 5, and 6, and profile drawings, and extending over the thick strokes, from the under side of the gun-deck shelf to the lower edge of the thickstuff, above the cross-piece heads.

That all crutches and hooks be of iron (except those for the decks), with ears, as shewn in the Drawings; and whenever they cross the limber strakes, to have an ear and bolt through each strake; and that the limber plates be, in all cases, of cast iron three inches thick.

That all fastenings of shelf-pieces, water-ways, knees, and riders, be made available for fastening the outside plank and thickstuff with "double and single fastenings," and that such additional fastenings as may be required to make that system good, be made up by treenails; and where the bolts in the shelf-pieces, &c., fail to make proper butt fastenings, they be made good with through bolts of seven-eighths of an inch in diameter.

Surveyor.

The scantling may be reduced, if treenails are done away with.
W. S.

Surveyor.

I see no improvement in the scale shewn in the table referred to.
W. S.

Surveyor.

N.B. Foreign ships have wales of twelve inches.
W. S.

Surveyor.

This is adopted in all new ships.
W. S.

Surveyor.

All projections are done away with, except that the sheer strakes and channel wales remain to assist the port lids.
W. S.

That the several beams, shelf-pieces, water-ways, thickstuff, planking, &c., be of the dimensions shewn in the following tables, viz.:—

			Three-Decked Ships.	Two-Decked Ships.	Large Frigates.
Beams.	Hold, if any	Sided . .	12	12	—
		Moulded .	12	12	—
	Orlop . .	Sided . .	16	14½	11
		Moulded .	16	14½	11
	Lower Deck	Sided . .	17	16½	11½
		Moulded .	17	16½	11½
	Middle .	Sided . .	16	—	—
		Moulded .	14	—	—
	Upper .	Sided . .	13½	13½	14
		Moulded .	12½	12½	13
	Quarter and Forecastle	Sided . .	10	10	10
		Moulded .	9	9	9
	Roundhouse	Sided . .	7	7	—
		Moulded .	7	7	To be reduced at the ends to 6 in.
Shelf-Pieces.	Orlop . .	In and Out	16	15	11
		Deep . .	16	15	11
	Lower Deck	In and Out	17	16	12
		Deep . .	17	16	12
	Middle .	In and Out	16	—	—
		Deep . .	12	—	—
	Upper .	In and Out	14	15	15
		Deep . .	13	12	12
	Quarter and Forecastle	In and Out	12	12	12
		Deep . .	8	8	8
Waterways. To be coaked with Iron Dowels of $\frac{3}{8}$ in. thick.	Lower Deck	Sided . .	14	14	12
		Moulded .	11	11	9
	Middle .	Sided . .	13	—	—
		Moulded .	10½	—	—
	Upper .	Sided . .	13	13	13
		Moulded .	10	10	10
	Quarter and Forecastle	Sided . .	11	11	11
		Moulded .	9	9	9
	Roundhouse	Sided . .	9	9	—
		Moulded .	8	8	—
Plank of the Bottom			5	5	4
Main Wales			9	8	7
Middle do.			6	—	—
Channel			5	6	—
Sheer Strakes			4	4	4

The thickness of the wales to taper at the fore and after ends about one sixth, and all the plank which runs up under the lower counter rail to taper at that part to three inches.

All projections to be done away with, and the planking between the wales and sheer strake to have a fair diminish.

The plank is also to taper regularly between the upper edges of the sheer strake to the under side of the plansheer of quarter-deck, forecastle, and roundhouse, where it is to be two and a half inches.

Surveyor.

There is such a variety of bows and sterns in the Navy, that I am at a loss to find data on which to form a comparison.

It is necessary to have ports in every direction on bows and sterns, in order that guns may be moved from one to the other, as the direction of the object to be fired at changes; and I can discover no reason for placing ports at a great distance apart, as they will most probably never be worked or fired simultaneously. I again refer to my remarks on the stern of the "Boscawen" on the 5th April, where my opinion is fully described.

W. S.

		Three-Decked Ships.	Two-Decked Ships.	Large Frigates.
LimberStrakes	Number of Strakes .	Two	Two	One
	Thick . .	9 in.	9 in.	6 in.
Thickstuff at Floor-heads	Number of Strakes .	Three	Three	Two
	Thick . .	9 in.	8 in.	6 in.
Do. at firstFuttock-heads	Number of Strakes .	Two	Two	Three
	Thick . .	8 in.	8 in.	6 in.
Do. at second Futtock-heads	Number of Strakes .	Two	Two	Two
	Thick . .	7 in.	7 in.	6 in.
Do. at third Futtock-heads	Number of Strakes .	Two	Two	—
	Thick . .	7 in.	7 in.	—
Orlop Clamps	Number of Strakes .	—	—	—
	Thick . .	as described	on the Sec	tions.
Spirketting	Lower Deck	7 in.	6 in.	6 in.
	Middle. .	6 in.	—	—
	Upper . .	4½ in.	5 in.	4½ in.
	Quarter . & Forecastle	3 in.	3 in.	3 in.
Flat of Decks	Orlop . .	3 in. fir	3 in. fir	—
	Lower Deck	5 in. oak	5 in. oak	3 in. fir
	Middle. .	4 in. 10 Strakes from the side, and two next the comings to be of Dantzic oak.	—	—
	Upper . .	4 in.	4 in. 10 Strakes from the side, and two next the comings to be of Dantzic oak.	4 in. 9 Strakes from the side, and two next the comings to be of Dantzic oak.
	Quarter . & Forecastle	4 in. fir	4 in. fir	4 in. fir
	Roundhouse	3 in. fir	3 in. fir	3 in. fir

That part of the decks in a range with the cables, to be, in all cases, of oak or other hard wood, except African.

The Committee having, in the foregoing recommendations given, as they conceive, the utmost possible strength to each and every part of the ship, now proceed to offer plans for the construction of the bows and sterns of Her Majesty's ships of war, which they conceive will admit of the guns being placed so as to "give the best possible means of offence and defence at every point, without interfering with their powers of sailing against a head sea."

With this view, they first formed tables shewing the present power of some of what they considered to be the best bows and sterns for each class of large ships in Her Majesty's Service, together with the bows and sterns proposed by Mr. Blake, in his letter to their Lordships of the 21st December last, and by Mr. Roberts; having done this, they laid down the following rules for their guidance in the construction of their plans, viz.:—

That in no case should there be less than nine fee between the centres of the guns, except on the quarter-deck and forecastle, where there should not be less than 8 feet 6 inches.

Surveyor.

In the "Trafalgar" "Vernon," and other sterns planned by Mr. Lang, the protrusion of the false work embarrasses, and in many instances renders the port useless.

The timbering of the stern is so massive and heavy, the openings for light and ventilation so few, that an extraordinary immersion abaft is the consequence, which must have a bad influence on the properties of the ship, and it cannot be imagined that such a weight of useless timber at the extreme, and on the superstructure, can be beneficial in any respect.

W. S.

Surveyor.

In all new ships this has been the practice, and the channels are in consequence narrower; but in the old ships their breadth of beam would not admit of it, as it would infringe too much on the angle of the rigging, and the consequent support of the masts.

W. S.

That the disposition of the ports on each deck should be such that the two opposite bow guns may cross the fire of each other, and that the bow or second gun, may cross the fire of the foremost broadside gun, when it is trained forward.

That the right aft guns, on the two sides of the stern on each deck, should cross the fire of each other.

That the quarter guns and the right aft guns at their greatest angle of training, should also cross the fire of each other; and that the quarter gun, and the after broadside gun, should also cross the fire of each other, so that if possible, there may be at least two guns on each deck made to bear on any one point.

That in addition to these general principles, which they laid down for the disposition of the ports, they considered it most desirable in the construction of bows and sterns, *that every gun should be perfectly free from obstructions*, and that no part should remain (except the half-ports and sashes) to be unfixed, when the guns are required to be used.

That there should be no external obstructions within the influence of the explosion, and that every thing on the outside should be without a cone of 90°, the apex of which being at the mouth of the gun, and the axis being on the line of the bore, or beyond a cone of 45°, which should revolve on a line produced from the bore. This was considered to be without the embrasure, which is commonly given in batteries to clear the explosion, and would make the gun perfectly effective (*see* Drawings Nos. 7, 8, and 9), and secure the side from accident.

They also considered it desirable that the common form of topsides should be in a line parallel to the shrouds, so that the channels may be narrowed as much as possible, to remove the present obstructions to the training of the guns, as by this means the muzzles of the guns at their greatest angle of training, would always be without the shrouds and chain plates. The whole of these advantages they consider to have been accomplished in the designs forwarded herewith, in which they have endeavoured to pay as much regard to beauty of appearance as was consistent with the formation of a formidable battery, and being adapted for ships of the old construction ("Caledonia," &c.), could be still better carried into effect in ships of greater breadth.

The annexed tables will shew the comparative degrees of training, the greatest number of guns that can be fought in the bows and sterns, and the distances between their centres, &c. in the several ships named therein, of those proposed by Mr. Blake and Mr. Roberts, and of those designed by the Committee; and also explain the relative powers of each ship in their most essential points.

Besides the plans, upon which they have reported in detail, the Committee have had under their consideration, by direction of their Lordships, a great number of others, many of them of a very ingenious nature, but not being calculated to answer the purposes intended, or the disadvantages greatly preponderating, they could not be recommended for adoption: others were of a very crude and impracticable nature, on which, after bestowing much time, and attention to the explanations of their several proposers, they were unable to discover anything worthy of attention; but they beg to assure their Lordships, that they have throughout the course of their deliberations been guided by an anxious desire to accomplish the objects which their Lordships had in view in appointing them to these duties, and have given a most careful and dispassionate consideration to every subject which has been brought under their notice; and they cannot conclude their Report without expressing an anxious hope, that as regards the main object to which their attention has been directed, viz., that of adding as much additional strength as possible to the construction of our Ships of War, and of giving the best fortification to their bows and sterns, they will have succeeded to the extent of their Lordships' expectations.

The various Drawings, Models, and Papers connected with our enquiries are forwarded herewith, as well as the Minutes of our proceedings, which will explain the grounds of our decisions upon such propositions as are not included in this Report; the entries of our several Reports will be forwarded in the course of a few days. Awaiting your furthe directions,

We have, &c.

T. F. HAWKES.
R. BLAKE.
J. W. FINCHAM.
J. ATKINS.

OLIVER LANG,
With the exception of the deadwood and ekeing pieces, as shown in Sketches 1, 2, 3, and iron riders on the plank, in 4, 5, 6, which is objectionable. See Observations, Appendix No. 3.

A.

(*Referred to in Surveyor's Observations.*)

(Copy.) *Pembroke Yard, May* 1836.

An Account shewing the Rate per Ton for building and fitting the undermentioned Ships for a State of Ordinary, on Sir Robert Sepping's principles; also, in red ink, the Price each Ship cost per Ton more than the " Vanguard," *viz.*—

Rate.	Guns.	Ships' Names.	Burden in Tons.	Expense of Building and Fitting each for a State of Ordinary.			Rate each Cost per Ton.			Price each Ship Cost per Ton more than the "Vanguard."		
				£	s.	d.	£	s.	d.	£	s.	d.
3	84	Clarence .	2,279	64,384	0	0	28	5	0	9	18	6
..	..	Formidable .	2,279	64,279	0	0	28	4	1	9	17	6
..	..	Powerful .	2,279	65,922	0	0	28	18	6	10	12	0
..	74	Defence .	1,741	62,524	0	0	35	18	3	17	11	9
..	..	Hercules .	1,726	65,411	0	0	37	17	11	19	11	5
..	..	Minotaur .	1,741	62,129	0	0	35	13	8	17	7	2
..	..	Total . .	12,045	384,649	0	0	..			..		

Likewise, the Rate per Ton for building and fitting the undermentioned Ship for a State of Ordinary, on Captain Symonds's principle, viz. :—

3	80	Vanguard .	2,608	47,787	0	0	18	6	6	..		

N.B.—It may be necessary to observe that the above Ships have *not* been selected, these being the only ones I had an opportunity of getting the expense of.

An Abstracted Account of the Quantity, Value, and Description of Converted Timber and Thickstuff contained in the respective Frames of the undermentioned Ships, viz.—

Species.	Clarence.					Vanguard.					Collingwood.				
	Loads.	Feet.	Value.			Loads.	Feet.	Value.			Loads.	Feet.	Value.		
			£	s.	d.			£	s.	d.			£	s.	d.
Converted English Oak .	562	35	10,510	0	0	493	14	9,316	0	0	327	22	6,143	0	0
Do. African . .	..	..	..			22	43	327	0	0	13	43	199	0	0
Do. Italian . .	2	31	41	0	0	43	30	689	0	0	179	13	2,927	0	0
Do. Larch . . .	..	..	..			2	27	20	0	0	1	34	13	0	0
Do. Elm	13	27	132	0	0	9	2	88	0	0	11	31	114	0	0
Total . .	577	93	10,683	0	0	569	16	10,440	0	0	531	143	9,396	0	0

Mem.—In my Report on the comparative expense of building the " Clarence," and " Vanguard," dated 30th November, 1833, I stated that the keels, the sterns, and the frames of both ships so approximated in point of consumption of materials, as to render it unnecessary to make a comparison on those points; and for the following reasons—because both ships have their keels, sterns, floors, futtocks, &c., in almost an equal number of pieces, and nearly of the same dimensions; but it is very different with the timber used in the "*hold, and certain other parts,*" as immense logs are used in the " Clarence" for diagonal riders, &c., which are not required in ships of the present construction, so that it needs *no further comment* to prove the *saving thereby effected.* The principal cause of the difference in the quantity of timber consumed in the respective *frames* arises *from the adaptation, in its growth, for that purpose.* I have, therefore, made the above statement, in order to shew the falsehood of the assertions made by parties on that subject, wherein they state that the *form* of the " Vanguard " is calculated to consume a very much greater quantity of timber than the *form* of the " Clarence," which assertion *I positively deny*; for, if the frames to both ships were converted from the same species and description of timber, there would be less used in the frame of the " Vanguard" than in the frame of the " Clarence."

The growth of Italian timber is particularly well calculated for constructing the frames of ships, that it converts very much more economically than English, as the preceding statement clearly proves; for it may be observed, by the quantity of Italian used in the frame of the " Collingwood," that, in proportion to the extent of the use of that description of timber, the consumption diminishes, and the diminution, in its rough contents, is still much greater, because very little more is necessary than barely to remove the surfaces, whilst from English timber it is necessary to take off large pieces in order to mould it. And, further, I will venture to assert that the ships of the *present construction* do not require so much *compass timber* as those of the late construction; for it has but very seldom been found to be necessary in any ship that has been *built*, or that is *building* in this Yard, on the present principle, *to scarph a timber*; but it is a well-known fact that it was absolutely necessary, and was the general practice, to *scarph nearly all the fourth and fifth futtocks from the mizen* channels aft, in order to form the curvature in that part of all round-sterned ships; also, in the round-sterned ships, the great majority of the futtocks are so very nearly of the *same length* as to render it *impossible to procure* so many pieces of timber of suitable lengths that will convert advantageously, however *great the store;* therefore, it was always found necessary to *cut large pieces or junks off the ends* of most of them, which created great waste, whilst in ships of the *present construction the frames consist of such a great variety of very different lengths*, that the store *will at all times furnish suitable timber* without cutting so much off the ends, which not only prevents waste, but *makes the ships stronger;* as, instead of having *but one timber between two heads, there are, according to the* PRESENT *method,* THREE. In order to make this matter more explicit, I shall here give a statement shewing the *various* lengths of the timbers used respectively in the midship frames of the "Clarence" and "Vanguard," viz.—

Description of Timbers.	CLARENCE.	VANGUARD.	
	Length of Timbers in the Frame, and Filling ditto.	Length of Timbers in the	
		Frame.	Filling Do.
	Ft. In.	Ft. In.	Ft. In.
Floors or Cross Pieces	18 0	14 4	16 9
Do. Half do.	15 9	..	..
Futtocks, First	11 3	19 5	19 6
Do. Second	11 0	12 11	17 7
Do. Third	12 4	17 10	13 6
Do. Fourth	12 3	18 6	13 1
Do. Fifth	24 7	14 9	14 6
Do. Sixth	..	15 5	7 11
Top Timbers	18 6	8 10	..

It may be observed, that the timbers of the frame and fillings are one and the *same* length in the "Clarence," whilst the frame and fillings of the "Vanguard" are of *very different lengths*.

CAPT. SIR W. SYMONDS, R.N., (*Signed*) T. F. HAWKES.
Surveyor of the Navy.

ON THE FRAME.

See Papers herewith on the subject from Mr. Hawkes, on the timber used in the "Clarence," *old* plan, and the "Vanguard," new plan.

Further, if the old method had been continued, the frames of the *three* 90-gun ships at Plymouth, *two* 80-gun ships at Chatham, the 90 and 110 at Portsmouth, with *three* 80-gun ships at Pembroke, would not have been provided in a space of less than *two* years from the store of the Yards, which I attribute entirely to this new shift of frame. (*See* Comparative Drawings of the old and new shift, and particularly the observations of Mr. Hawkes in his remarks on the providing the frame of the "Clarence" and that of the "Vanguard.")

Again, the butts of the old shift are alternately used in one continuous line, which shews its weakness; and it is known that ships have separated at the floor-heads when taking the ground, and this is the cause also of their being bilged; while the new shift gives three whole timbers between the *two butts*, and of course twice the strength. In conversion of the frame it provides facilities, as the fifth timber is nearest its shape and length, while in the old frame it is the *third;* and in no instance need the converter be at a loss for any particular piece, as every log when taken out of the stack, may be appropriated either to the frame or filling frame, as the heads of each frame give a shift of the full length to each other, and the filling timber to the sirmark-head, which is half the shift.

B.

Report *on the proposed Plan, by Captain Symonds, for filling in Ships of War.*

Sheerness, 1*st October*, 1832.

Captain **King** states :—

He has consulted the Master Shipwright and his Assistant upon the plans proposed, and that they agree with him there appears not any objection, on the score of strength and durability, to the solid timber fillings being carried no higher than the floor-heads, and substituting the plan proposed, with the suggestion that the fillings shall be three inches thick as the minimum.

(*Signed*) A. KING.

Plymouth Yard, 16*th October*, 1832.

Captain Ross reports on the proposed plan, as follows—*with his Officers* :—

The solid fillings approved of; and they see no objection to the external fillings above the floor-heads, but are of opinion that ceiling should be introduced, as also a thick strake at the floor-heads for riders or truss-frames to butt against; and they propose that an iron plate over a chock, and the heel of the rider, should be placed in the bearing of the ship.

(*Signed*) C. B. H. ROSS.

Portsmouth Yard, 4*th October*, 1832.

Sir F. **Maitland** reports, with the Officers' opinion, on the plan proposed :—

Considers it a matter entirely professional, and cannot venture to offer an opinion at variance with the Officers, and their experience, on the duration and effects produced on the timbers of ships by filling them in.

The Master Shipwright is convinced that the defects observed in ships at present are not caused by the plan pursued, but is in consequence of the timber used for fillings being of an inferior quality to the frame of the ship.

(*Signed*) F. L. MAITLAND.

Portsmouth Officers, Messrs. **Nolloth**, **Blake**, and **Ayling**.

They are of opinion, that the plan proposed is a very inadequate substitute for that at present practised, as regards strength and durability.

Consider the ship would be weak for want of security on the inside, if ceiling be not resorted to, as was usual before filling in was introduced into the Navy.

State the openings would become foul, by matter more injurious than fillings of inferior materials.

They consider that filling in the openings with timber of the same quality as the frame of the ship, together with a portion of almost imperishable material, cannot be so prejudicial to the ship's durability as the impurities of the foul openings when open.

They consider that when the openings are filled in it is equal to a portion of ballast.

As relates to the part which extends above (the original fillings) the orlop clamps, as per Memorandum of the 28th May, 1831, " being a protection from shot between wind and water," it is considered the outside filling is not a substitute, and that that part of the frame is sufficiently secure by the wales, planking, clamps, &c., for strength.

As there is good air in this part, the objections stated to the openings in the hold do not apply, and they think the plan proposed prejudicial than otherwise.

(*Signed*) J. NOLLOTH,
R. BLAKE,
J. AYLING.

Chatham Yard, 4*th October*, 1832.

Sir J. **Gordon** sends the following report from *his Officers* :—

Surveyor.

The " Harrier" and " Forester" are both instances of this injurious system.

W. S.

Mr. Stone states, when ships are filled in above the part saturated with water, he has found the frame of the ship to be uniformly decayed.

Admits that under some circumstances it would be desirable to fill them in; yet from every consideration, to fill in higher than the floor-heads, except in the smaller classes, would be injurious.

Considers the plan *proposed preferable to the mode now in practice*, but is apprehensive that the plank of the bottom in wake of the fillings and timbers would be *subject to decay and fungus.*

Approves of filling in the ship solid, to the *floor-heads to a certain height, but not to the upper surface* of the timber inside, it being necessary to have a *water-course* to the *timbers* in the openings, by keeping the fillings slack of the size of the floor.

It is advisable in the small vessels, brigs, &c., that they be not filled above the first futtock-heads.

(*Signed*) W. STONE.

Mr. Hawkes— *Chatham.*

Considers the plan proposed to be preferable to that of the 5th March, 1831, and is of opinion that all fillings have a great tendency to *accelerate the decay* of the *timbers and outside plank.*

But as fillings from the floor-heads down have been the means of preserving a ship when the keel and plank have been beaten off, he proposes to fill in to that height from the *outside only,* to about one-half or two-thirds of the thickness of the frame, which he considers equally as effectual for security *as if solid,* and the opening above would allow the water to pass to the pumps.

In reference to the state of the *frame of ships* that have *been filled in, his assurance is, that they have almost invariably been found decayed.*

It frequently occurs that when the openings are large, the oakum is driven through the seams, he suggests that no openings should be more than three inches.

(*Signed*) T. F. HAWKES.

Mr. Weekes— *Chatham.*

States that in all cases where fillings have been introduced between the timbers of the frame, at any considerable height above the floor-heads, the *timbers and plank* have been *found more decayed* than that part *without fillings.*

Proposes that the fillings to the floor-heads be kept down four or five inches below the timbers, for a water-course across the ship. In small vessels, if the openings are large, to carry the fillings to midway between the floor and first futtock-heads, as a protection to the heels of the second futtocks.

(*Signed*) J. WEEKES.

Captain-Superintendent Bullen— *Pembroke, 6th October,* 1832.

Transmits the following, in accordance with his own ideas on the subject of filling in ships on the plan proposed by the Surveyor, Captain Symonds.

First. As regards the large class of ships, they see no objection to filling in solid to the *floor-heads* with timber according to, and substituting from thence to the height proposed, the plan submitted by Captain Symonds.

As they consider the openings to be small in large ships, and that whatever method may be adopted in the filling in, that little advantage of strength will be gained by it, they think that the advantages will be confined to its security from leaks, by any failure in the outside planking.

They perceive there is no prevention of an accumulation of dirt in the openings, by the plan proposed.

In small vessels where the openings are large and nearly equal to the timbers, objections may be made on the score of strength and durability, as the solid fillings on the old plan gave strength as well as durability by the inside planking being done away, and it also prevented an accumulation of dirt in the openings.

Although the system of solid fillings is objectionable, and requires the aid of injecting to obviate the evils attendant on it, they offer an opinion, that it would be desirable to fill in with solid wood where the floors and half-floors are insufficient in siding (to the old floor-head's height), and from thence to the load-water line, with oak in and outside, and the space to be filled with cement and sand, as that method is not liable to the injurious consequences produced by wood. They prefer light wood about the load-water-line, as directed by the Board's Letter of the 27th May, 1831, to be filled in solid, with light wood, and of a durable quality.

In small vessels, although there is strength given by solid fillings, and slight protection from shot, yet the weight added to her is highly injurious to the vessel as a sea-boat, and which more than counterbalances the advantages; and as it is considered the frames of these vessels are not of a scantling to resist or prevent a shot from penetrating, it is recommended that no fillings be above the floor-heads in midships.

(*Signed*) C. BULLEN, *Superintendent.*
J. PEAKE, *Master Shipwright.*
J. PRETIOUS, *Assistant ditto.*
W. BALL, } *Foremen.*
J. ALLEN. }

Captain Superintendent WARREN— *Woolwich*, 18*th October*, 1832.

Sends the Report of the Master Shipwright, and his Assistant, separately, and adds his opinion as follows:— That to prevent dry rot, is to cause a free circulation of air, but when it cannot be done, to fill in and exclude it entirely, *if possible.*

Considers the filling in on the outside, as proposed by *Captain Symonds*, will admit a free circulation of air, and will tend to increase the strength, stability, and durability of the ship, and *thinks it advisable to adopt the plan proposed*, and that it should extend to all classes, and continue to three or four feet above the load-water-line.

(*Signed*) SAMl. WARREN,
Superintendent.

Mr. LANG's Report. *Woolwich*, 18*th October*, 1832.

Is of opinion all ships should be filled in solid with oak, to two feet above the floor-heads, and from thence to eighteen inches above the water-line with larch or cedar, and that all should be well seasoned. Fillings to be made in two parts, rabetted and put together, and then felt placed between them and next the sides of the timbers. All the fillings to be two inches less than the moulding of the frame timbers. The injurious method of seaming and caulking is the cause of decay to timbers and fillings.

As relates to the plan proposed by Captain Symonds, he considers the fillings are not sufficient, as they would soon become useless from shrinkage, and want of security, and offer no resistance against that compared with the solid.

(*Signed*) OLIVER LANG,
Master Shipwright.

Mr. ABETHELL— *Woolwich*, 4*th October*, 1832.

Is of opinion that solid fillings below being of wood, there can be no objection to, as to strength or otherwise; and above, thinks the proposed plan is equal to solid.

As relates to security from leaks, the proposed is equal to solid, and should be as they are shown in the sketch.

Is of opinion that the plan proposed will be conducive to the durability of the ship, it being impossible to exclude the atmosphere, moisture, and wet, which, by being partially done, generates fungus and other decay.

Considers the plan proposed has advantages over the other in economy and lightness, and there can be no difficulty in its being carried into effect.

(*Signed*) R. ABETHELL.

C.

Portsmouth Yard, 18*th July*, 1842.

Sir,

With reference to your Memorandum of the 16th instant, to report the state of the beams of the several decks of the "Pique," we beg to state that we have examined the beams on the different decks, and have not perceived any signs of straining or weakness whatever.

In this ship none of the beams are scarphed in the original manner, and therefore we cannot compare the two plans under like circumstances; but our opinion is, that they will stand equally well with the old plan beams, provided they are wholly made of English or African oak.

(*Signed*) R. BLAKE,
T. STURDIE,
J. WATTS.

The following is the amount of weight saved, and the expense reduced on the beams of a ship of each class, over those of the *old plan* :—

Guns.	Tons.	£	s.	d.
110	48	1108	12	0
80	28	663	15	0
36	14	312	10	0
26	8	189	15	0

APPENDIX No. 1.

Woolwich Yard, 15*th January*, 1842.

Sir,

In conformity with your directions of the 12th instant, for us to examine and report on the efficiency of the timbering of the " Boscawen's " stern, we beg to state that we have carefully examined the construction, in relation to the general security of the stern, as well as the management of the timbering, and are of opinion that the shift of timber is not good, and that, as they are at present disposed, the stern is likely to be weak; but we consider that by introducing about four timbers on each side, to give shift to the heads and heels of those which are now up, where the shift is short, by moving the quarter-port further forward as may be found necessary, and by running the ekeings of the several deck transoms round to the second beam, as shewn in the plans of the decks for this ship, dated June, 1841, and, in addition, introducing a flat sill transom to each deck, the stern, as regards strength, may be made efficient.

We have, &c.
(*Signed*) T. F. HAWKES,
R. BLAKE,
J. FINCHAM,
J. ATKINS.

Sir Francis A. Collier, C.B., K.C.H.
Captain-Superintendent.

APPENDIX No. 2.

Woolwich Yard, 1*st February*, 1842.

Sir,

With reference to your directions of the 19th ultimo, to consider and report on the efficiency of the "Boscawen's" stern for fighting her guns as well as for strength, we beg to state, that we have in consequence had a carriage with a model gun placed on each deck, and find that from the position of the right aft ports on the lower deck, the muzzles of the guns cannot be run out sufficiently far by about two feet six inches, nor those of the quarter-ports on the same deck, by six inches; the latter will be obviated by the alterations proposed in our Report of the 15th ultimo, and the guns then brought to cross the fire of the broadside ports; but as regards the right aft ports, no remedy can be proposed without a total alteration of her stern. The guns on the other decks can all be worked efficiently.

We have, &c.
(*Signed*) T. F. HAWKES,
R. BLAKE,
J. FINCHAM,
J. ATKINS.

Sir Francis A. Collier, C.B., K.C.H.
Captain-Superintendent.

APPENDIX No. 3.

Woolwich Yard, 13*th April*, 1842.

Sir,

In consequence of the Committee having come to resolutions, on the diagonal truss frame and safety keel, which my judgment and experience strongly condemn, and as they have never had a fair opportunity ot fitting a ship on the proper principles, or proving its merits by actual examination, I cannot allow a mere opinion, in direct opposition to many incontrovertible facts, to pass unnoticed; and think it but just to state the reasons why I do not subscribe to their resolutions. It is now twenty-three years since I fitted down truss frames, and about forty vessels of different descriptions on this principle, have come under my attentive observation during that period, not one of them has shown any alteration in form, or the least weakness, notwithstanding the great weight of engines, boilers, coals, &c., on board, without any beams below the upper deck, for the space of upwards of forty feet, to support their sides, while other vessels on the old system have worked, broken their sheer, and destroyed their fastenings.

The following narrative of the dangers the "Lightning" has encountered, will prove not only the security derived from the safety keel, but the great strength to the fabric and fixedness of form, given by the iron diagonal trussing let into the inside of the timbers, and spreading over the entire surface of the vessel, from the keel to the gunwale, and from the stem to the stern, connecting the whole body together; this vessel was constructed by me as before described, upwards of twenty years since. On her first cruize she ran on shore on the Spaniard Sand, and fell over on her bilge, the tide leaving her, she lay dry several hours, but sustained no injury; on getting afloat, proceeded to Dover, ran against the pier, and carried away her gripe; this was repaired, and she went to Algiers; on her return, encountered a very heavy gale in the Bay of Biscay; after which, she weathered a tremendous storm in the Irish Channel, in company with the "Erin" steamer, both bound for Dublin, the latter ship worked to such an extent, that she soon became water-logged and foundered. On the "Lightning" reaching Dublin, she ran on the rocks and carried away the whole of her external keel, and greatly injured the planks of her bilge, but was got off without any leakage, and remained at sea six weeks, when she was taken into dock and new keels were fitted. The following winter she ran on the Coal Rock, near Copenhagen, where she hung by the middle for ten hours, working up and down, when having dislodged her external keel, was got off and driven to sea, where she was caught in a hurricane in company with the "Superb" steamer, just before that ship foundered: she weathered this storm also, and arrived safely at Woolwich, when again her keels were made good. Since which, she ran on the rocks off Holyhead, displaced the greater part of her keels and injured her bottom; the injury having been repaired, she soon

Surveyor.

I consider the use of iron diagonal riders indispensable, and that they cannot, in moderation, be too widely adopted.

W. S.

The mode of fitting keels herein alluded to, was proposed by Mr. John Peake, in the year 1791. It has been claimed by others also.

W. S.

The mode of forming the larboard strakes should depend upon the store of timber, and the convenience of conversion.

W. S.

after ran on shore on her passage from Scotland to Woolwich, and injured her forefoot and keel. Another time, when lying alongside the Wharf at Jersey, dry on hard ground, supported by a rope from the shore at her mast-head, the rope breaking, she fell over on her bilge with a violent shock, but sustained no injury. Since this, a similar accident occurred at Ostend, and to this day she preserves her true form, notwithstanding she has been grounding and floating every tide, for several months alongside the river wall at Woolwich, with her engines and boilers on board. After such repeated proofs of strength and safety given, it would be absurd in the extreme to transfer the iron riders from the timbers to surface of plank, which cannot be brought fairly to adhere to the frame, but is subject to shrinkage, splitting, decay, and movement, from its loose, unconnected condition; as these riders so placed by the Committee terminate at the under side of the lower deck, and the very heavy weight of guns above, on the side of the ship, commencing from this place, there will be the hinge for the working of the ship. And as my judgment is established by a long and most careful consideration, grounded not only on the above incontrovertible facts, but many others, among which may be mentioned the "Trafalgar," 120 guns, which was thus fitted, and when launched broke her sheer very much less than any other first-rate, I must decline signing that part of the Report so inconsistent with reason, where the Committee have recommended a less safe mode of fitting the keels, and a considerable weaker mode of trussing the frame, which I declare will leave the ships, as regards the security and stability of the fabric, in a worse state than the Committee found them.

I have &c.

(*Signed*) OLIVER LANG.

Sir F. A. Collier, C.B., K.C.H.
Captain-Superintendent.

Admiralty, 5*th April*, 1842.

With reference to their Lordships' minutes, of the 24th and 30th ultimo, on the subject of the alterations in the "Boscawen's" stern, recommended by the Committee of Master Shipwrights, I have examined minutely the Drawings, and find that the additional weight of timber will materially affect the ship's sailing qualities, being about as *eleven* is to *seven*; and find that the defensive power of the ship is lessened by the change; that the space for acommodation is curtailed, and similar to the "Trafalgar." The cabins and ward-room are divested of proper light and air, the ward-room having but one square port in it, which will be totally incapable of using a gun, being immediately abaft the rudder head; the quarter gallery doors are too narrow to admit a gun (a circumstance that nearly proved fatal to the "Phœnix" in the war), and owing to the shifts of the frame, the main wales, tho large rudder port, which divests the stern of two continuous timbers, I do not consider the stern and after-body in any respect, so strong and useful as the original.

Certainly the stern guns, through the counter, go out further; but as this is obtained by lessening the projection left of the counter, which I hold to be an integral, essential, and indispensable feature in the ship's form, for safety, security to the rudder, space for accommodation, and for working the ship, and also to receive the established spanker boom, which in the Committee's stern, the centre of boom would be carried out more than three feet beyond the crutch, I beg most respectfully to urge their Lordships to pause, for I conscientiously believe that this stern would materially injure the ship's properties, deforming the after-body, deteriorating the battery, and rendering the accommodation dark, and devoid of ventilation.

ST. GEORGE:

As altered by Mr. Roberts.

	Gun Deck.	Middle Deck.	Upper Deck.	Quarter Deck and Forecastle.	Round-house.	Total.
BOW.						
FOREMOST GUN.						
Distance from its opposite Gun	29 ft.	10 ft.	21 ft.	10 ft. 4 in.	..	..
Angle with the line of the Keel . Converge	From To	From To 23° ..	From To 4° ..	From To 30° ..	..	..
Diverge	12° 66°	.. 53°	.. 41°	.. 53°	..	..
Cross the opposite Gun at a distance of . .	will not cross fire	10 ft.	150 ft.	8 ft.	..	..
SECOND GUN.						
Distance from foremost Gun	None	8 ft.	None	8 ft. 6 in.	..	..
Angle with the line of the Keel . Converge	.. ..	0 ..	.. ..	.. ..	..	..
Diverge	.. ..	.. 82°	.. ..	7° 86°	..	..
Cross fire with Bow Gun, at a distance of .	..	8 ft.	..	9 ft.	..	..
BROADSIDE GUN.						
Distance from the Gun before it	14 ft.	12 ft. 6 in.	10 ft. 9 in.	12 ft. 4 in.	..	..
Training . . . . Converge	.. ..	.. ..	.. ..	.. ..	..	..
Diverge .	43° ..	26° ..	36° ..	37° ..	..	..
Cross fire with the Gun before it, at a distance of	38 ft.	12 ft.	147 ft.	14 ft.	..	..
Number of Guns that will fire in a line with the Keel, both sides	None	four	two	two	..	8
	Deduct, being too near each other by 12 inches . . .					2
						6
STERN.						
AFTER GUN.						
Distance from its opposite Gun	12 ft.	10 ft. 3 in.	middle	8 ft. 9 in.	..	..
Angle with the line of the Keel . Converge	will not run out by 1 ft. 6 in.	From To 28° ..	From To 27° ..	From To 26° ..	..	..
Diverge .		.. 36°	.. 27°	.. 40°	..	..
Cross the opposite Gun, at a distance of .	will not cross fire	8 ft.	middle gun	7 ft.	..	..
Muzzle outside the Counter	18 in.	within	..	..	..	..
QUARTER GUN.						
Distance from After-Gun	11 ft.	9 ft. 6 in.	9 ft. 2 in.	7 ft. 3 in.	..	..
Angle with the line of the Keel . Converge	.. ..	.. ..	2° ..	.. ..	..	..
Diverge .	22° 77°	12° 72°	.. 53°	10° 82°	..	..
Cross fire with the Right-aft Gun, at a distance of	will not cross fire	21 ft.	13 ft.	12 ft.	..	..
BROADSIDE GUN.						
Distance from Quarter Gun	11 ft. 3 in.	13 ft.	15 ft. 8 in.	16 ft. 3 in.	..	..
Training . . . . Diverge .	40° ..	34° ..	37° ..	38° ..	..	..
Cross fire with the Quarter Gun, at a distance of	15 ft.	18 ft.	52 ft.	28 ft.	..	..
Number of Guns on both sides, that will fire in a line with the Keel	None	two	three	two	..	7
Number of Guns on the Roundhouse, that will fire in a line with the Keel, if required	..	..	..	..	One	1

TRAFALGAR:

As built by Mr. Lang.

	Gun Deck.	Middle Deck.	Upper Deck.	Quarter Deck and Forecastle.	Round-house.	Total.
BOW.						
FOREMOST GUN.						
Distance from its opposite Gun	23 ft. 6 in.	10 ft.	18 ft. 3 in.	8 ft. 6 in.	..	..
Angle with the line of the Keel . Converge	From To 0 ..	From To 14° ..	From To 12° ..	From To 33° ..	..	..
Diverge	.. 74	.. 55°	.. 37°	.. 50°	..	..
Cross the opposite Gun at a distance of . .	on line with keel	17 ft.	42 ft.	7 ft.	..	..
SECOND GUN.						
Distance from foremost Gun	None	8 ft.	None	8 ft. 6 in.	..	..
Angle with the line of the Keel . Converge	.. ..	5° ..	.. ..	2° ..	..	..
Diverge	.. ..	.. 78°	.. ..	.. 69°	..	..
Cross fire with Bow Gun, at a distance of .	..	7 ft.	..	7 ft.	..	..
BROADSIDE GUN.						
Distance from the Gun before it	14 ft.	10 ft. 6 in.	9 ft. 6 in.	13 ft. 3 in.	..	..
Training . . . . Converge	.. ..	.. ..	.. ..	.. ..	..	..
Diverge .	28° ..	30° ..	27° ..	37° ..	..	..
Cross fire with the Gun before it, at a distance of	15 ft.	12 ft.	48 ft.	27 ft.	..	..
Number of Guns that will fire in a line with the Keel, both sides	wo	four	two	four	..	12
	Deduct, being too near each other by 12 inches . . .					2
						10
STERN.						
AFTER GUN.						
Distance from its opposite Gun	12 ft. 6 in.	middle gun	12 ft. 9 in.	middle gun	..	..
Angle with the line of the Keel . Converge	From To 11° ..	From To 37° ..	From To 29° ..	From To 39° ..	..	..
Diverge .	.. 19°	.. 37°	.. 39°	.. 39°	..	..
Cross the opposite Gun, at a distance of .	35 ft.	middle line	11 ft.	middle line	..	..
Muzzle outside the Counter	8 in.	without	..	..	..	..
QUARTER GUN.						
Distance from After-Gun	10 ft. 6 in.	ft. 4 in.	11 ft.	11 ft. 6 in.	..	..
Angle with the line of the Keel . Converge	.. ..	9° ..	.. ..	8° ..	..	..
Diverge .	13° 66°	.. 52°	26° 97°	.. 66°	..	..
Cross fire with the Right-aft Gun, at a distance of	112 ft.	14 ft.	54 ft.	12 ft.	..	..
BROADSIDE GUN.						
Distance from Quarter Gun	11 ft.	13 ft.	14 ft.	12 ft. 9 in.	..	..
Training . . . . Diverge .	46° ..	39° ..	49° ..	38° ..	..	..
Cross fire with the Quarter Gun, at a distance of	300 ft.	55 ft.	16 ft.	27 ft.	..	..
Number of Guns on both sides, that will fire in a line with the Keel	Two	three	two	three	..	10
Number of Guns on the Roundhouse, that will fire in a line with the Keel, if required	..	..	..	..	Four	4

MR. BLAKE'S FIRST RATE.

	Gun Deck.	Middle Deck.	Upper Deck.	Quarter Deck and Forecastle.	Round-house.	Total.
BOW.						
FOREMOST GUN.						
Distance from its opposite Gun	22 ft. 3 in.	9 ft. 9 in.	17 ft.	10 ft. 3 in.	..	..
Angle with the line of the Keel . Converge	From To 6° ..	From To 16° ..	From To 10° ..	From To 14° ..	..	..
Diverge	.. 63°	.. 65°	.. 26°	.. 66°	..	..
Cross the opposite Gun at a distance of . .	116 ft.	15 ft.	43 ft.	17 ft.	..	..
SECOND GUN.						
Distance from foremost Gun	10 ft.	6 ft. 6 in.	None	7 ft. 3 in.	..	..
Angle with the line of the Keel . Converge	.. ..	15° ..	.. ..	11° ..	..	..
Diverge	30° 85°	.. 61°	.. ..	.. 72°	..	..
Cross fire with Bow Gun, at a distance of .	14 ft.	5 ft.	..	6 ft.	..	..
BROADSIDE GUN.						
Distance from the Gun before it	12 ft.	15 ft.	13 ft.	13 ft.	..	..
Training . . . . Converge	.. ..	.. ..	.. ..	.. ..	..	..
Diverge .	57° ..	38° ..	42° ..	36° ..	..	..
Cross fire with the Gun before it, at a distance of	ft.	39 ft.	will not cross fire	19 ft.	..	..
Number of Guns that will fire in a line with the Keel, both sides	Two	four	two	four	..	12
	Deduct, being too near each other by from 30 in. to 15 in.					4
						8
STERN.						
AFTER GUN.						
Distance from its opposite Gun	15 ft. 9 in.	middle	, middle	middle	..	..
Angle with the line of the Keel . Converge	will not run out by 10 in.	From To 36° ..	From To 34° ..	From To 35° ..	..	..
Diverge .	.. ..	.. 36°	.. 34°	.. 35°	..	..
Cross the opposite Gun, at a distance of .	none	middle gun	middle gun	middle gun	..	..
Muzzle outside the Counter	18 in.	within	..	..	..	..
QUARTER GUN.						
Distance from After-Gun	11 ft. 6 in.	14 ft.	14 ft.	13 ft.	..	..
Angle with the line of the Keel . Converge	.. ..	.. ..	.. ..	.. ..	..	..
Diverge .	29° 73°	4° 67°	11° 70°	11° 73°	..	..
Cross fire with the Right-aft Gun, at a distance of	will not cross fire	23 ft.	29 ft.	27 ft.	..	..
BROADSIDE GUN.						
Distance from Quarter Gun	10 ft. 6 in.	25 ft. 6 in.	19 ft.	13 ft.	..	..
Training . . . . Diverge .	33° ..	44° ..	49° ..	44° ..	..	..
Cross fire with the Quarter Gun, at a distance of	34 ft.	51 ft.	45 ft.	25 ft.	..	..
Number of Guns on both sides, that will fire in a line with the Keel	None	one	one	one	..	3
	Or by using the intermediate Ports			..	..	6
Number of Guns on the Roundhouse, that will fire in a line with the Keel, if required	..	..	..	..	Two	2

FIRST RATE.

Proposed by the Committee of Master Shipwrights.

	Gun Deck.	Middle Deck.	Upper Deck.	Quarter Deck and Forecastle.	Round-house.	Total.
BOW.						
FOREMOST GUN.						
Distance from its opposite Gun	21 ft.	10 ft.	17 ft. 6 in.	8 ft. 6 in.	..	..
Angle with the line of the Keel . Converge	From To 2° ..	From To 16° ..	From To 12° ..	From To 30° ..	..	..
Diverge	.. 65°	.. 57°	.. 30°	.. 40°	..	..
Cross the opposite Gun at a distance of . .	300 ft.	15 ft.	40 ft.	7 ft.	..	..
SECOND GUN.						
Distance from foremost Gun	9 ft. 9 in.	9 ft. 3 in.	None	8 ft. 6 in.	..	..
Angle with the line of the Keel . Converge	.. ..	0 ..	.. ..	2° ..	..	..
Diverge	21° 89°	.. 76°	.. ..	.. 74°	..	..
Cross fire with Bow Gun, at a distance of .	10 ft.	8 ft.	..	10 ft.	..	..
BROADSIDE GUN.						
Distance from the Gun before it	9 ft. 9 in.	10 ft. 9 in.	11 ft. 6 in	15 ft.	..	..
Training . . . . Converge	.. ..	.. ..	.. ..	.. ..	..	..
Diverge .	38° ..	30° ..	27° ..	42° ..	..	..
Cross fire with the Gun before it, at a distance of	8 ft.	14 ft.	188 ft.	25 ft.	..	..
Number of Guns that will fire in a line with the Keel, both sides	Two	four	two	four	..	12
STERN.						
AFTER GUN.						
Distance from its opposite Gun	11 ft.	middle	9 ft.	middle	..	..
Angle with the line of the Keel . Converge	From To 26° ..	From To 36° ..	From To 30° ..	From To 38° ..	..	..
Diverge .	.. 32°	.. 36°	.. 43°	.. 38°	..	..
Cross the opposite Gun, at a distance of .	9 ft.	middle	6 ft.	middle	..	..
Muzzle outside the Counter	18 in.	without	..	..	..	..
QUARTER GUN.						
Distance from After-Gun	9 ft. 6 in.	9 ft. 9 in.	9 ft.	9 ft. 6 in.	..	..
Angle with the line of the Keel . Converge	0 ..	21° ..	0 ..	22° ..	..	..
Diverge .	.. 54°	.. 52°	.. 60°	.. 53°	..	..
Cross fire with the Right-aft Gun, at a distance of	13 ft.	8 ft.	10 ft.	8 ft.	..	..
BROADSIDE GUN.						
Distance from Quarter Gun	12 ft. 9 in.	15 ft. 3 in.	1[illegible] in.	16 ft. 6 in.	..	..
Training . . . . Diverge .	45° ..	51° ..	48° ..	50° ..	..	..
Cross fire with the Quarter Gun, at a distance of	58 ft.	640 ft.	64 ft.	288 ft.	..	..
Number of Guns on both sides, that will fire in a line with the Keel	Four	three	four	three	..	14
Number of Guns on the Roundhouse, that will fire in a line with the Keel, if required	..	..	..	..	Four	4

O. LANG. T. F. HAWKES. R. BLAKE. J. FINCHAM. J. ATKINS.

	MARS.					HINDOSTAN: *As altered by Mr. Roberts.*					80-GUN SHIP. *Proposed by the Committee of Master Shipwrights.*				
BOW.	Gun Deck.	Upper Deck.	Quarter Deck and Forecastle.	Round-house.	Total.	Gun Deck.	Upper Deck.	Quarter Deck and Forecastle.	Round-house.	Total.	Gun Deck.	Upper Deck.	Quarter Deck and Forecastle.	Round-house.	T
FOREMOST GUN.															
Distance from its opposite Gun	16 ft.	18 ft. 6 in.	9 ft.	..	..	14ft. 9in.	13 ft. 6 in.	9 ft. 6 in.	..	..	19 ft. 6 in.	12 ft.	8 ft. 6 in.	..	
	From To	From To	From To			From To	From To	From To			From To	From To	From To		
Angle with the line of the Keel — Converge	.. ..	8° ..	21° ..	..	..	3° ..	11° ..	23° ..	..	..	9° ..	28° ..	37° ..	..	
Angle with the line of the Keel — Diverge	2° 57°	.. 29°	.. 60°	..	..	.. 60°	.. 19°	.. 53°	..	..	.. 65°	.. 57°	.. 38°	..	
Cross the opposite Gun at a distance of .	Will not cross fire	64 ft.	8 ft.	..	..	130 ft.	34 ft.	8 ft.	..	..	54 ft.	10 ft.	6 ft.	..	
SECOND GUN.															
Distance from Foremost Gun	9 ft.	None	7 ft. 6 in.	..	..	..	..	..	..	..	None	9 ft. 6 in.	8 ft. 6 in.	..	
Angle with the line of the Keel . — Converge	.. ..	.. ..	3° ..	..	..	.. ..	.. ..	.. ..	..	..	.. ..	0 ..	6° ..	..	
Angle with the line of the Keel . — Diverge	13° 79°	.. ..	.. 81°	..	..	.. ..	.. ..	.. ..	..	..	.. ..	.. 85°	.. 79°	..	
Cross fire with Bow Gun at a distance of .	9 ft.	..	6 ft.	..	..	.. ..	..	..	..	..	..	8 ft.	7 ft.	..	
BROADSIDE GUN.															
Distance from the Gun before it	12 ft. 6 in.	15 ft.	9 ft. 6 in.	..	..	18 ft.	13 ft.	21 ft.	..	..	10 ft. 6 in.	12 ft. 6 in.	12 ft.	..	
Training . . . . — Converge	.. ..	.. ..	.. ..	..	..	.. ..	.. ..	.. ..	..	..	.. ..	.. ..	.. ..	..	
Training . . . . — Diverge	32° ..	20° ..	16° ..	..	..	35° ..	27° ..	39° ..	..	..	.. 24°	.. 31°	.. 30°	..	
Cross fire with the Gun before it, at a distance of	12 ft.	78 ft.	7 ft.	..	..	40 ft.	will not cross fire	88 ft.	..	..	14 ft.	11 ft.	11 ft.	..	
Number of Guns that will fire in a line with the Keel, both sides	None	two	four	..	6	Two	two	two	..	6	Two	four	four	..	1
	Deduct, being too near each other by 12 inches .				2										
					4										
STERN.															
AFTER GUN.															
Distance from its opposite Gun	12 ft.	9 ft.	8 ft. 6in.	..	..	10 ft. 6 in.	9 ft.	middle	..	..	10 ft. 6 in.	middle	8 ft. 9 in.	..	
		From To	From To				From To	From To			From To				
Angle with the line of the Keel . — Converge	Will not run out	28° ..	24° ..	..	..	.. ..	19° ..	30° ..	..	..	19° ..	41° ..	39° ..	..	
Angle with the line of the Keel . — Diverge	.. ..	.. 35°	.. 34°	..	..	.. ..	.. 27°	.. 30°	..	..	.. 28°	.. 41°	.. 42°	..	
Cross the opposite Gun at a distance of .	Will not cross fire	6 ft.	6 ft.	..	..	..	9 ft.	middle	..	..	12 ft.	middle	5 feet	..	
Muzzle outside the Counter	18 in. within	..	..	..	..	10 in. within	..	..	..	..	18 in. without	..	..	..	
QUARTER GUN.															
Distance from After-Gun	12 ft.	9 ft. 6 in.	..	..	..	9 in.	9 ft.	9 ft.	..	..	9 ft. 6 in.	11 ft.	8 ft. 9 in.	..	
Angle with the line of the Keel . — Converge	.. ..	1° ..	..	..	..	.. ..	.. ..	12° ..	..	..	0 ..	24° ..	0 ..	..	
Angle with the line of the Keel . — Diverge	17° 59°	.. 66°	1° 68°	..	..	18° 54°	6° 65°	.. 52°	..	..	.. 59°	.. 49°	.. 68°	..	
Cross fire with the Right-aft Gun, at a distance of	Will not cross fire	11 ft.	11 ft.	..	..	Will not cross fire	19 ft.	10 ft.	..	..	20 ft.	7 ft.	11 feet	..	
BROADSIDE GUN.														..	
Distance from Quarter Gun	10 ft. 6 in.	21 ft.	12 ft.	..	..	10 ft. 9 in.	13 ft.	19 ft. 6 in.	..	..	11 ft.	20 ft.	14 ft.	..	
Training . . . . Diverge .	47° ..	42° ..	31° ..	..	..	40° ..	30° ..	40 ..	..	..	.. 36°	.. 33°	.. 37°	..	
Cross fire with the Quarter Gun at distance of	40 ft.	50 ft.	18 ft.	..	..	36 ft.	16 ft.	82 ft.	..	..	24 ft.	78 ft.	23 feet	..	
Number of Guns on both sides that will fire in a line with the Keel	None	four	two	..	6	None	two	three	..	5	four	three	four	..	1
Number of Guns on the Roundhouse that will fire in a line with the Keel, if required	..	..	..	two	2	..	..	..	Three	3	..	..	..	Three	

AMERICA: *As altered by Mr. Roberts.*			EAGLE.			CHICHESTER.			50-GUN FRIGATE. *Proposed by the Committee of Master Shipwrights.*		
Upper Deck.	Quarter Deck and Forecastle.	Total.	Upper Deck.	Quarter Deck and Forecastle.	Total.	Upper Deck.	Quarter Deck and Forecastle.	Total.	Upper Deck.	Quarter Deck and Forecastle.	Total.
21 ft. From To	11 ft. From To	..	22 ft. From To	9 ft. 6 in. From To	..	18 ft. From To	10 ft. From To	..	18 ft. 6 in. From To	10 ft. From To	..
.. ..	11° ..	..	.. ..	.. ..	..	7° ..	16° ..	..	11° ..	31° ..	..
5° 38°	.. 55°	..	19° 43°	1° 51°	..	.. 25°	.. 68°	..	.. 33°	.. 55°	..
Will not cross fire	25 ft.	..	Will not cross fire	will not cross fire	..	75 ft.	14 ft.	..	46 ft.	8 ft.	..
..	7 ft. 3 in.	..	None	7 ft.	..	..	..	..	None	8 ft. 9 in.	..
.. ..	.. ..	..	.. ..	.. ..	..	.. ..	.. ..	..	.. ..	0 ..	..
.. ..	13° 79°	..	.. ..	34° 92°	..	.. ..	.. ..	..	.. ..	.. 77°	..
..	6 ft.	..	..	Too near the Bow Gun	..	..	..	..	..	8 ft.	..
14 ft.	10 ft.	..	13 ft.	..	..	12 ft.	14 ft.	..	12 ft. 6 in.	9 ft. 6 in.	..
.. ..	.. ..	..	43° ..	34° 92°	..	.. ..	.. ..	..	.. ..	.. ..	..
32° ..	29° ..	..	.. ..	.. ..	..	24° ..	21° ..	..	.. 30°	.. 32°	..
135 ft.	11 ft.	..	Will not cross fire	50 ft.	..	490 ft.	17 ft.	..	180 ft.	9 ft.	..
None	two	2	None	none	none	Two	two	4	Two	four	6
11 ft. From To	middle From To	..	Middle From To	14 ft. From To	..	10 ft. 6 in. From To	middle From To	..	9 ft. From To	middle From To	..
20° ..	35° ..	..	21° ..	20° ..	..	29° ..	35° ..	..	38° ..	36° ..	..
.. 37°	.. 35°	..	.. 21°	.. 38°	..	.. 43°	.. 36°	..	.. 44°	.. 36°	..
13 ft.	middle gun	..	Middle gun	18 ft.	..	8 ft.	middle line	..	6 ft.	middle	..
..	..	..	..	..	..	..	..	..	..	..	..
9 ft. 6 in.	10 ft. 6 in.	..	9 ft.	7 ft.	..	9 ft.	10 ft. 6 in.	..	9 ft. 6 in.	8 ft. 6 in.	..
.. ..	9° ..	..	2° ..	.. ..	..	.. ..	11° ..	..	0′ ..	25° ..	..
12° 74°	.. 58°	..	.. 23°	24° 96°	..	12° 85°	.. 58°	..	.. 67°	.. 52°	..
14 ft.	10 ft.	..	13 ft.	22 ft.	..	16 ft.	11 ft.	..	15 ft.	16 ft.	..
12 ft.	9 ft.	..	14 ft.	12 ft. 6 in.	..	9 ft.	11 ft.	..	12 ft.	14 ft. 6 in.	..
38° ..	30° ..	..	52° ..	48° ..	..	37° ..	35° ..	..	.. 49°	.. 37°	..
20 ft.	17 ft.	..	Will not cross fire	18 ft.	..	9 ft.	25 ft.	..	35 ft.	53 ft.	..
Two	three	5	Three	two	5	Two	three	5	Four	three	7
..	..	..	..	..	..	..	..	..	..	..	..

O. LANG. T. F. HAWKES. R. BLAKE. J. FINCHAM. J. ATKINS.

Observations upon the Remarks of the Surveyor of the Navy on Paragraphs extracted from a joint Report from the Committee of Master Shipwrights.

Such observations of the Surveyor as are adverse to the recommendations of the Committee, having been sent to each of the Master Shipwrights, desiring them to state, respectively, if such observations caused any alteration of their opinions on the said points, the following replies were transmitted by each.

From Mr. HAWKES, *Plymouth Dock Yard.*

Surveyor.	*5th February,* 1843.
I consider that the doing away with the quarter port, on the point of impunity, is a great sacrifice. The Chatham Officers' Report, of the 5th May, proves that the defects complained of in the frame of the "Boscawen" principally arose from the improper mode adopted by the Woolwich Officers, as that defect did not exist in the "Cumberland."	The proposed doing away with the quarter port, was in consequence of the fire from the right aft port nearest the side being made to cross the fire of the after broadside port upon every deck, by which means there would be no point of impunity. Although I concurred in opinion with the other Officers, that the fire from the right aft guns on the lower deck could not be made to clear the ship (which we were told was indispensable) without taking down the stern, I never should have advised its being taken down, knowing that many of our square sterned ships, which had been most conspicuous in the great actions, housed their guns quite as much within the counter, more especially as I still retained the opinion I had held for many years, that the projecting counter might be more frequently of importance to keep the ship from being pooped, than objectionable as likely to have guns fired from it. There can be no doubt that the defects discovered in the stern of the "Boscawen" arose more from the improper disposition of the timber of which it was composed than any other cause, which induced the Committee to recommend the introduction of additional timbers, &c., to give it the requisite strength.
Surveyor. I am of opinion that the shift of frame adopted in the Service is superior to this recommendation; and I am borne out in that opinion by a Report of Mr. Hawkes, dated November 30th, 1833, wherein he compares the frames of the "Clarence," and "Vanguard," which Report is sent herewith (see A).	It was not because my opinion had undergone the least alteration respecting the mode of framing ships adopted by Sir William Symonds in the "Vanguard" and other ships, on which I reported the 30th of November, 1833, but in conformity to a rule by which we pledged ourselves on the first day of our meeting,—viz., to agree to the opinion of the majority, and "to afford greater latitude in the selection of the timber," that I joined in the recommendation.
Surveyor. I feel convinced, from full experience, that the mode adopted in November 1832 is far superior to any other mode of scarphing beams, both with regard to strength and economy (see Report sent herewith).	With respect to the mode for scarphing beams, adopted in November 1832, although lighter and more economical, it is in my opinion not sufficiently strong in proportion to their length when the screws are cut out opposite each other for the reception of the mast and hatchway carlings.

Surveyor.

I am strongly opposed to the use of treenails: bolt nails are much superior, and great improvement would be accomplished if they were general.

I have been many years of opinion that treenails are a treacherous as well as a perishable fastening, being frequently broken off by the caulkers in reaming the seams: and from the superior security of metal fastenings without cutting the grain of the timbers by such large holes as the treenails, they would admit of a reduction in siding, which would effect a saving, in the expense of timber, more than sufficient to cover the expense of substituting copper fastenings. It was only in compliance with the opinion of a majority of the Committee being in favour of treenails, that I joined in recommending them.

Surveyor.

I can discover no reason for placing ports at a great distance apart, as they will most probably never be worked or fired simultaneously.

The distance between the ports in the bows and sterns proposed by the Committee, was given officially by Sir Thomas Hastings from the "Excellent," at Portsmouth.

(*Signed*) T. F. HAWKES.

From Mr. BLAKE, *Portsmouth Dock Yard.*

Reasons, *in detail,* for adhering to his former opinion respecting the Shift of Frame for Ships.

Surveyor.

I am of opinion that the shift of frame adopted in the Service is superior to this recommendation; and I am borne out in that opinion by a Report of Mr. Hawkes, dated November 30th, 1833, wherein he compares the frames of the "Clarence" and "Vanguard," which Report is sent herewith (see A).

The alteration proposed to be made in framing our ships of war was unanimously agreed to by the Committee, and I still hold the same opinion.

Whatever might have been intended by the plan of introducing three timbers between the two butts of heads and heels of the frame futtocks, it is attended with many disadvantages in the conversion of the ship's frame, and I am of opinion, detrimental to the strength of the ship; and in carrying the present plan into effect, from the timbers passing or running over each other so short a distance as two feet six inches, or two feet nine inches, it necessarily requires a too close adherence by the converter to the prescribed length at the heads and heels, otherwise, if they should be drawn nearer together, the system of three timbers between the heads must be destroyed, and the plan rendered abortive.

By the plan proposed, the roundest futtocks may be converted two feet shorter or longer than the prescribed heads, without injury or detriment to the strength of the ship. The timbers, generally speaking, above and below, are obtained with greater ease from being less compass, and wherever a deficiency of length may have occurred in the conversion of more compass timber, it may be made good by over-length in the timber above or below. And although the Committee, in their recommendation, think that the minimum length of the shaft of the timber, or over-running of one head from the other, should be six feet, I would recommend that this may be extended for first or second rates, to seven feet, making the timbers fourteen feet long instead of eleven feet, as at present; and this length can be obtained with greater ease from the Italian timber, from its admirable growth for frames of ships, than eleven feet from that of English growth: and in order to vary the lengths of the several conversions, to suit the growth of the framing timber in store, as much as possible, and to offer additional strength to the ship in wake of the lower deck, where strength is most required, I presented a sketch to the Committee, showing an increased length of scarph, and I herewith transmit a copy of the same, in which the timbers falling under the upper deck ports in *two*-decked ships, and under the middle deck ports in *three*-decked ships, and also the timbers falling under the lower deck ports are made, independently of their increased length of scarph, to run lower in the ship, thereby affording greater strength in the wake of the knee fastenings.

To shew the applicability of Italian timber to increased length of frame timber, I have taken the lengths from the receipt of twenty pieces of each description indiscriminately, from thirteen to seventeen and a half inches siding, and find the average lengths are from eighteen to twenty feet, and none shorter than thirteen feet, and only four pieces of that reduced length out of one hundred and eighty pieces. It thereby appears most desirable that some plan should be established to use such valuable timber near its received lengths; for it should be observed that the Italian timber may, generally speaking, be converted to its *full* length.

And speaking generally of the present mode of framing, I do not consider that timber averaging thirteen inches square, with a shift only of two feet nine inches, that the strength of these two pieces can ever be called into action, but that where this reduced shift exists there must be a hinge or yielding of the frame; and that however the frame of the shift may be improved in particular parts, upon the maxim that nothing is stronger than its weakest parts, it is evident that the ship's strength is reduced at the situation pointed out on the sketch before alluded to; and all the chain bolting that can be applied will not make up for the loss of strength, when compared to the former mode of framing ships, by having the butts or heads and heels of two timbers placed in the middle or thereabout of the other timber.

I have been thus particular in describing, as far as my recollection will assist me, the motives that weighed with myself and the Committee, carrying with it, in my opinion, more importance than any subject that came under our consideration, in determining on an alteration necessary to be made, not only for the improvement of the strength of the ship's frame, but for the economy and good appropriation of the store of timber now in Her Majesty's

Yards; the finest stock, and best grown perhaps, that was ever in possession of the Government: and I might here observe, that the late Mr. Canham presented to the Committee a shift of timber for admitting three timbers between two heads, which he had many years since laid before the late Navy Board, and was by them rejected.

(*Signed*) R. BLAKE.

Opinion on the subject of Scarphing Beams.

Surveyor. feel convinced, from full experience, that the mode adopted in November 1832 is far superior to any other mode of scarphing beams, both with regard to strength and economy (see Report sent herewith, C).	When the Committee determined on an increased length of the scarph of the beams, I conceived that it only had reference to beams constructed partly with larch or fir, made of three pieces.
Surveyor. I cannot recommend their being so close; I consider from sixteen to twenty inches quite sufficient. I would prefer thicker deck plank.	*Half Beams.* When the Committee adjudged the distance of the half beams, it was done with a view to make the decks last a longer time, and to sustain the weight of the heavy armament now generally introduced.
Surveyor. I consider the forked knees very superior in point of strength.	*Iron Knees.* The plan of forming iron knees with two ears, met with the general consent of the Committee; and I still retain the same opinion, that these knees are not inferior in strength to the forked knees now employed for the security of beam-ends, and they are equally efficacious in confining it to the shelf. The saving in labour and materials, in manufacturing knees upon this plan, as compared with the forked knee, is about 33 per cent.
Surveyor. I see no improvement in the scale shown in the Table referred to.	*Dimensions of Beams, Shelf-pieces, Water-ways, &c.* I think the scale of dimensions of beams, shelf-pieces, and water-ways, &c., was introduced by the Committee in consequence of the building strakes being dispensed with. But, individually, I am opposed to the thick water-ways, as unnecessarily consuming timber of large dimensions and of great value, and affording very little security in connecting the beam to the ship's side. This I hope to prove to the satisfaction of their Lordships, by an experiment which I propose to make by aid of the testing machine, when it shall be erected.

(*Signed*) R. BLAKE.

Reasons, *in detail*, for adhering to former opinion respecting Treenail Fastenings.

Surveyor.

I am strongly opposed to the use of treenails; bolt nails are much superior, and great improvement would be accomplished if they were general. No good shipwright would fasten the flank as herein alluded to, and scantling may be reduced, if treenails are done away with.

Treenail fastening, in the manner recommended, met with the unanimous approbation of the Committee, and I am still of the same opinion.

I have never conversed with any shipwright, living or departed, that objected to treenail fastenings; and, of late years, since the treenails have been mooted by a machine, they have become more efficacious, and from fitting the holes very exactly, rarely or never leak, which they formerly used sometimes to do, when mooted by an axe or plane. Their disuse would render it necessary to employ an enormous capital, equal to the value of the metal required for bolts and bolt nails. When ships fastened entirely with metal come to be broken up, the difficulty of extracting the bolt nails would be so great, that a large proportion of them will unavoidably be sold with the old timber.

Lord Minto, in his visits to this Yard, has more than once interrogated me on this subject. I told him that our ships in the last war had gone through so much trial and service as might, perhaps, never again be required; and I had never yet heard of a ship being rendered unserviceable in consequence of a failure in the treenail fastenings; and that a large portion of the "Royal George," consisting of the lower part of the stern, and inner posts, deadwood, and a considerable part of the bottom planking, exposing to view several of her butts, as well as the afterwood end, which were secured solely by treenails, were invariably in a sound state. I have known ships complain of the treenail fastenings, when made from other timber than English oak, as in the case of the "Naiad," now in this harbour, which ship has her plank fastened with African treenails. I have also known English treenails to be decayed, particularly in merchant vessels; but this has arisen from the treenails being either manufactured from green oak, or driven into unseasoned materials.

(*Signed*) R. BLAKE.

Reasons for adhering to former opinion respecting Iron Riders, or Diagonal Plates.

Surveyor.

I am opposed to this suggestion, as it would add much to the smiths' work, without an equivalent; for the fabric, I am convinced, would be stronger, if the riders, crutches, hooks, &c., were let into the frame.

I am opposed to the use of iron riders, or diagonal plates, in ship building, in whatever form they may be made or applied. I consider the application as only materials laid diagonally, chiefly depending on the fastenings, and can only be considered, at best, as ties; and whenever a particular strain is brought on iron, it has no tendency to recover its original form: and, if iron plates were found to be efficacious, ridges on the copper could not so frequently occur at the extremities of those ships so attempted to be strengthened; and I am of opinion, that nothing but substantial trussing will support a ship's sheer or arching for a length of time.

In every extensive fabrication of timber, trussing is applied, and a ship is the only instance of its being departed from; and I agree in opinion with Professor Robinson, as expressed in the "*Encyclopædia Britannica*," under the head of "Carpentering;" and the same opinion is adopted by Treadgold, "that a skilful carpenter never employs many iron straps, considering them as auxiliaries foreign to his art." In carrying the plan of trussing into effect, I differ in a great degree from the method pursued by the late Sir R. Seppings, not thinking it necessary to the carrying the trussing system so low in the hold, or silent part of the ship. I presented to the Committee a plan of trussing, shown by model, for carrying the same into effect in the vertical part of the ship, between the orlop and lower deck, where substantial abutments are obtained, and can be carried into effect without adding to the weight of the ship's sides. There are many evident reasons why trussing must surpass diagonal iron fastenings; when a ship is strained or bending from age, a wood trussed frame can have the abutments renewed by caulking, or iron plates, whereas no renewal can take place in the other case. And in this place I cannot forbear mentioning, that, by accident, I had the opportunity of showing the model (previous to its being presented to the Committee) to the celebrated and experienced Civil Engineer Mr. Jesse Hartley, who, for many years, has had the conducting of that vast establishment, the Liverpool Docks; perhaps, no individual in this country is better qualified to give an opinion as to the combination of timber, than that gentleman. He observed to me, "that from the abutments to the trusses being so secure, and the general arrangement of the same being so good, I am of opinion that a ship so built cannot alter her sheer or break." And, in conclusion, I would strongly recommend that the trusses between the ports, as practised by the late Sir R. Seppings, should be perpetuated (increasing their thickness to improve their abutments). Wherever the yielding of the fabric of a ship is found to take place, it is natural to suppose that the topsides, or the part of the ship farthest from the keel, would suffer most, and that the trussing between the ports must act powerfully to prevent this inclination. And I trust I may be excused in expressing my firm belief, that, sooner or later, a substantial system of trussing, on sound principles, will be again resorted to, to give strength and longitudinal support to those great floating fabrics, whose formation at the extremities, in order to obtain velocity in sailing, does not admit of adequate support being given by the water to sustain the great weights above at those parts. The effect of the weight at the extremities of our large ships exceeding the upward pressure of the water, is manifest, at times, in new ships by the puckering of the copper sheathing, immediately they are floated out of dock, after being coppered. And I take this opportunity of stating my opinion, that something is wanting in the whole of our Ships of war, as a substitute for what our forefathers introduced as riders in the hold, for strengthening the ship on the bilge, in the event of taking the ground. At present, the ship has no other support than her common frame timbers, and by the diagonal iron plates, which can never for a moment be considered as of any consequence to a ship in such danger. Under such circumstances, I am therefore of opinion, that it is imperative that some means of giving additional strength should be applied to this part of the ship which takes the ground.

(Signed) R. BLAKE.

Opinions respecting Bows and Sterns.

Surveyor.

There is such a variety of bows and sterns in the Navy, that I am at a loss to find data on which to found a comparison.

Bows and Sterns.

As the arming of bows and sterns has engaged my attention for a number of years, and as I differed in opinion with a majority of the Committee on this subject, I beg leave to offer a few observations thereon.

I consider that by adopting the formation of the bow as in the "Vindictive," it will be attended with very considerable advantage in the employment of the artillery, by not only giving the means of bringing the bow guns to bear in the line of the keel, but enabling the outer guns on the several decks to cross in their fire, the fore and aft line of the ship, or the weather guns to be brought to bear upon an object on the lee bow. I herewith present a sketch of the forecastle of a second rate, explanatory of the same.* And I beg to observe, that from a recent determination of increasing the distance between the guns, the bows must in consequence extend to a greater distance than shown on the plans which I presented to the Committee, and which were the same that accompanied my letter to their Lordships, on the 21st October, 1841.

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* These sketches are shown for comparison; and I am of opinion the angular bow has many obvious advantages to that adopted by a majority of the Committee. It will be observed, that the outer gun of the former plan, distinguished by the letter Z, is enabled in its fire to cross the keel about one point, or the weather gun can be brought to bear on an object on the lee bow; whilst the outer gun of the plan proposed by the Committee, will but project the gun to a fore and aft line, as shown by the letter A. The inner gun can also by the angular form, be trained so far aft as to cross the broadside fire, as will be seen by the letter Y; whilst by the plan of the Committee, it can only be trained aft as far as shown by the letter *b*. It is evident the advantages that must accrue from using the guns conjointly, as Y, Z, until relieved by the broadside fire; this training of the inner gun on the "Vindictive," was by keeping the bowsprit well down below the forecastle deck. This obstacle of the bowsprit could not be experienced on the forecastle of a *two*-decked ship.

I am directly opposed to the method pursued by the Committee in fortifying the stern.

I am of opinion that the guns should be placed over each other, as no inconvenience can arise from this practice; and even in broadside guns, they are not exposed to more danger from being so placed.

By having the guns alternately, as proposed by the Committee, the arrangements of the stern lights are very much impaired. And I also disagree with the Committee in not making use of the gallery doors as ports, when occasion may require; as no better spot can be selected for a quarter gun.

Having the quarters constructed with elliptic galleries, which are, by naval men, considered to present a better appearance than those of the usual form, and affording better means of firing the guns without injury to the gallery itself, and they are much easier taken down by the ship's carpenters, if required; these are points on which sea officers are best qualified to give a correct judgment.

(*Signed*) R. BLAKE.

Reply, *in detail*, to Mr. Lang's Report, dated 13th April, 1842, respecting two plans in which Mr. Lang dissents from the Committee.

The case of Steam Boats does not appear to me to be at all analagous to that of heavily armed line-of-battle ships; because, from the very different arrangement of the weights in them, compared with the buoyancy of the water, the opposite effect frequently takes place in them to that which results from the relative weight and buoyancy in large Ships of War.

Trussing is therefore not so much required as a general bond of union between the parts, which I consider to be most effectually accomplished by diagonal iron plates, let in their own thickness into the inside of the timbers. In corroboration of the above opinion, I have heard that when the "Great Western" was docked at Pembroke, her keel was founded to be sagged, or curved downwards, very considerably.

As to diagonal iron plates let into the frame from keel to gunwale in our large ships of war, I consider them quite inadequate to answer, for any length of time, the purpose of trusses: they would be most serious obstacles to contend with, as regards the different fastenings and fitments connected with the topsides, &c., and would, in my opinion, be attended with much inconvenience and expense in repairs.

As to the safety keel, I think the practice that is pursued, with rabbets and counter rabbets, and expensive bolting, besides the consumption of timber of large scantling, and therefore increased value, to be quite unnecessary. I think the removal of the short thin chocks to the heels of the floors, and the reducing the heels of the first futtocks at the side of the keel, and making up this deficiency with fore and aft materials fastened to the timbers, and caulking the same previous to planking the bottom, and the ship's opening of the frame filled in as is now practised,—that a ship so treated is as safe in taking the ground, as when fitted on the plan termed the safety keel. And I cannot conclude these observations without expressing my surprise, as was also done by the Committee, at the manner in which these safety keels were intended to be wrought on the "Boscawen." So much of the heels of the timbers were cut away forward and aft, as to leave but little bearing against the deadwood; and we were at the time of opinion, that a shock received at the fore or after part of the ship, in the event of taking ground might easily upset the keel and appendages, and the ship be endangered. We therefore recommended to Mr. Lang to introduce lengthening chocks upon the heels of the timbers, previous to the plankings being brought on, to prevent the danger which we apprehended.

The fitting of the safety keel was, on this ship, of course under Mr. Lang's immediate direction: and I am convinced were their Lordships to call for a faithful report of the whole expense incurred in fitting the "Boscawen" on this plan, that it would be found so great as to induce their Lordships to discontinue this mode of working the keel and garboard strakes. I cannot conclude this paper without observing, that I have recently seen a document sent from the "Formidable," wherein it is expressed, in these words, that although the ship had suffered so much in her keel, gripe, &c., no leakage made its appearance anywhere except between the planking, and timbers of the ship; and this ship is simply filled in, without even fore and aft strakes to substitute the chocks.

(*Signed*) R. BLAKE.

From Mr. FINCHAM, *Chatham Dock Yard.*

In accordance with the directions of my Lords Commissioners of the Admiralty, contained in Sir John Barrow's Letter of the 21st ultimo, and with your Minute of the 23rd, calling on me to state whether the remarks of the Surveyor on the Report of the Master Shipwrights, made at Woolwich, between the 3rd January and the 15th April, 1842, have caused any alteration in my opinion on those points on which there is a difference of opinion between the Master Shipwrights and the Surveyor; and if not, to state my reasons or arguments in detail, for adhering to my former opinion, notwithstanding the Surveyor's said remarks, I have the honor to state that, having given to every subject on which the Committee were directed to deliberate my mature consideration, before coming to any determination thereon, and having again examined the views I had held, with great care and attention, I can see no reason to deviate, generally, from the opinion I held when the different points at variance with the views of the Surveyor were under the consideration of the Committee, and would most respectfully give my reasons for adhering to my former opinion.

"Boscawen's" Stern.

Before considering the remarks contained in the said letter, it may be proper to observe, that the attention of the Committee was directed to the circumstances of the "Boscawen's" stern, by Sir Francis Collier, on the 12th of January, by whom they were directed to report on the efficiency of the "Boscawen's" stern; and that, agreeably to such direction, the Committee examined the said timbers; and after due consideration, they reported that with the shift of timbers as then disposed, the stern was likely to be weak; but that with an alteration which they then submitted, the stern as it regarded strength might be made efficient (see Appendix 1). In accordance with an Admiralty order, of the 18th January, a statement of the expense of the alteration was sent; and in further accordance with an Admiralty order, of the 19th, the Committee made their Report of the 1st February, on the efficiency of the stern for fighting the guns, as well as in relation to the strength (see Appendix 2).

In proposing this alteration the Committee did not contemplate the use of any other armament than that which was then established; but that, with that establishment, the right aft guns on the lower deck would not run out so as to clear the explosion by two feet six inches, and the quarter guns by six inches. To adapt the stern, therefore, to the established armament, they considered that the only remedy which they could propose with confidence, was a total alteration in the stern, by which the right aft guns on the lower deck might be worked

"Boscawen's" Stern.

with safety; at the same time, they reported that the guns on the other decks *could* be worked effectively. In forming the new plan, they had in view only what was considered a defect in the "Boscawen's" stern, as it regarded effectiveness in fighting the guns; but in the Drawings forwarded on the 21st March, such a shift of timbers was shown as it was considered would meet any defect that existed in the "Boscawen's" stern. I am not, however, aware that any comparison was made with the "Cumberland;" or that the Chatham Officers, in making their report of the 4th May, had any reference to the "Boscawen's" stern; or that, when the alteration of the "Cumberland's" stern was subsequently made, any particular reference was had to the "Boscawen," beyond the instructions given in the Surveyor's Minute of the 30th May, directing the Officers to avoid all bad shifts and weak points complained of in the "Boscawen;" yet, on comparing the two sterns, I find but little difference except in timbering, and in the disposition of the points right aft, as may be seen by examining the Drawings marked A. These Drawings are as correct as I am at present able to make them; but I have not been able to discover the serious faults in the stern proposed by the Committee that are complained of in the Surveyor's remarks on this subject.

Stern.

In the Letter of the 5th April, the Surveyor has stated that he considers the additional weight of timber placed in the stern of the "Boscawen," as recommended by the Committee of Master Shipwrights, "will materially affect the ship's sailing qualities, being about as eleven is to *seven*." In order now to discover what will be the precise effect produced by the alteration contemplated by the Committee, I have carefully examined the two shifts of timbers in the sterns, and have cubed the timbers, and estimated the weights of them; and I find that in the "Boscawen's" stern, from the after part of the gallery door, and upwards from the gun deck, including iron work, would be 10 tons 16 cwt.; the "Cumberland's" stern, before the alteration, 10 tons 12 cwt.; the "Cumberland's" stern, as altered, 10 tons 13 cwt.; and the Committee's stern, 11 tons 15 cwt. Now taking the moments of these weights separately, with the view to ascertain how much the ship will be depressed by the stern, we have the "Boscawen's" moment, before the alteration, 1,027 tons; the "Cumberland's" moment, before the alteration, 1,008 tons; the "Cumberland's" moment, since altered, 996 tons; and the Committee's moment, 1,080 tons. Hence, it is apparent that if the additional weights were placed in the middle of the ship, she would be depressed bodily only one-twentieth of an inch, the area of the water line being about 8,200 feet; and by taking the moments of the weights, as

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acting at the extremity of the stern, the stern would be depressed only a quarter of an inch, almost an insensible quantity, which could never affect the sailing of the ship: and the moment of inertia is too small to affect the motion of the ship, being less than the results of many alterations that are constantly taking place in the disposition of weights that are placed on board of ships.

It is further stated in the Surveyor's Letter, "that the defensive power of the ship is lessened by the change." In making this statement, I would, however, submit, after careful re-examination of the arrangement, that some mistake appears to have been fallen into; since the right-aft and quarter guns on the lower deck, which could not be effectively fired from the "Boscawen's" former stern, are, in the stern proposed by the Committee made perfectly effective, as may be seen by inspecting Figures 1 and 2; whilst there is left no point round the stern on which two guns cannot be brought to bear, as is shown in Figures 3 and 4. With these objects attained, I must confess I am unable to see in what respect the defensive power of the stern can have been diminished by the alterations proposed. For should it be deemed objectionable to fight the midship gun on the upper deck, immediately over the rudder head, although I can see no reason why such an objection should be entertained, as the rudder head is short, and the scuttle over it is made sufficiently strong to bear and fight the gun, still there will be eleven guns right aft that will fire in a line with the keel, besides those on the poop (see Figure 5).

That "the space for accommodation is curtailed" must be admitted, as the rake of the stern cannot be lessened without doing this; but the diminution is so trifling that there seems no propriety in placing it in competition with the advantages gained to the effectiveness of the stern. See the space as shown between the dotted and drawn lines (Figure 6).

With regard to the cabins and ward-room being "divested of proper light and air," I observe, that should the openings be found incapable of supplying the quantity of light and ventilation that is sufficient for ordinary occasions, the objection might be easily obviated, by opening more of the spaces which form mock lights. The advantages and disadvantages of the alteration may, however, be compared by the following consideration, whilst it is admitted that the filling in of the spaces which were usually left for the stern lights must necessarily obstruct a portion of the light and air which it has been common to have admitted into the cabins and ward-room (see Figure 7). The filling in of these spaces supplies as great a barrier as possible to grape shot and musket balls; and in

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proportion as exposure to such shot is mischievous in a ship, so should any protection from it be estimated. Is, now, this protection from small shot an advantage more than equivalent to the diminution of light in these apartments? From what I have seen of ships after general actions, I am decidedly of opinion that it is; and, therefore, that the filling in of the openings proposed by the Committee, is a judicious alteration.

The "ward-room having only one square port in it, will be totally incapable of using a gun, being immediately abaft the rudder head." In this statement there appears to be a mistake, as in the stern proposed by the Committee for the "Boscawen," there were *three* right aft ports in the ward-room on the upper deck,—one at the middle line over the rudder head, and one on each side, with the centres of the guns ten feet from the middle line, so that the three guns, as to distance apart, may *all* be fought effectively; and it needs only a reference to the Drawing, to see that in a case of necessity for fighting this gun, no objection could be maintained against doing so, since the rudder head, as in common, is left short, and the covering of the hole would be sufficiently strong to bear the gun, as well when it is fought as when it is not.

In respect of "the quarter gallery doors being too narrow to admit a gun, a circumstance which nearly proved fatal to the 'Phœnix' in the war," I observe, that in the case of the "Phœnix" this might have been a serious disadvantage, but the same disadvantage cannot exist in connection with the arrangement for the guns which the Committee proposed. From the manner in which the stern of the "Phœnix" was formed, there was no possibility of the broadside and stern guns crossing fire; but in the stern proposed by the Committee, they do cross fire; and this arrangement entirely obviates the necessity of ever making a port of the quarter gallery door; for should the guns only fire in lines parallel to each other, they will always be able to strike an object within the distance that the centres of the guns are apart, perpendicular to the line of fire. Provided the distance between the after broadside gun and the right aft gun were sufficient, there could be no objection to the quarter gallery door being made large enough to admit a gun, beyond that of its being desirable that all the apertures in the side should be as small as possible, on account both of defence and strength.

"Owing to the shifts of the frame, the main wales, the large rudder port, which divests the stern of two continuous timbers, I do not consider the stern and after body in any respect so strong and useful as the original." On attentively re-examining and considering the frame in the two sterns, I cannot discover the grounds for these objections. As it

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regards the rudder hole, which is designated a "*large* rudder port," I beg to remark, that the Committee never contemplated having it larger than is common in ships of that class. And although there may be two continuous timbers cut off, yet the entire number of continuous timbers has not been diminished by the alteration, inasmuch as the space originally designed for a port has now the same number of long timbers as were necessarily cut off for the port recommended by the Committee; and as in the arrangement of the timbers as proposed by the Committee in the new stern, they take their regular shift, overlaunching each other to a distance that has always been found to give sufficient strength, I cannot conceive on what ground the alteration can be supposed to have weakened the stern. But as long timbers have been used, instead of snaping timbers, which form no regular shift with each other, there must, on that account, be an increase of strength in the frame of the stern (see Figure 8). With respect to the stern guns projecting further aft in relation to the counter, a result that "is obtained by lessening the projection of the counter," which is held "to be an integral, essential, and indispensable feature in the ship's form, for safety, security to the rudder, space for accommodation, and for working the ship, and also to receive the established spanker boom," it may be remarked, that the due protection of the rudder is a very desirable point, but the extent to which the ship s rudders are covered, varies very considerably; and the difference there is in the covering of the rudder, under the several alterations (see Figure 9),* can never, I conceive, be deemed equally important with the advantage gained to the effectiveness of working the guns on the lower deck, which, from their situation, must, under most circumstances, afford a greater protection to the rudder than could be obtained by any overhanging of the stern, however great. The difference of space for accommodation, for working the ship, and for receiving the spanker boom, will be best perceived by inspecting the accompanying Drawing (Figure 10). But should there be found to exist any inconvenience with regard to the working of the ship, and to the receiving of the spanker boom, such inconvenience might be easily obviated by some simple contrivance; since the Committee's stern has considerably more rake and space than the old round sterns had, but in which the practical difficulties that are stated to be incidental to the proposed stern have been surmounted.

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* The dotted line shows about what form would have been given to the post timbers by the Committee; but in forming the "Boscawen's" stern, they conformed to her post timbers as high as the sill, to avoid entering into any unnecessary work.

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That the Committee's "stern would materially injure the ship's properties, deform the after body, deteriorating the battery, and rendering the accommodation dark and devoid of ventilation," I am perfectly unable to reconcile with facts and well established principles ; since the form has not been altered below water, nor to some height above that line; and by diminishing the rake, the weight of the ship acts less powerfully in giving her a tendency to ascend by the stern. And yet from the observations which have been made by the Surveyor on this point, it appears that he considers this a disadvantage—a supposition apparently at variance with one of the principles of mechanics which regards the momentum of weights, or their distance from a fulcrum, as producing the effects; then obviously, as the distance is diminished, the absolute weight may be increased without increasing the effect. Nor have I been able to discover that any deformity has been the result of the alterations proposed by the Committee in the outline of the stern. The form of the stern, both before and after the alteration, is shown in the accompanying Drawings (see Figure 11). But as an actual instance has been already supplied to the Service, in the "Cumberland," the stern of this ship may be justly referred to as a fair specimen, as well in appearance as in effect, of what the Committee proposed to introduce as an improvement. And even should it be still insisted on by the Surveyor, that one effect of the alterations proposed by the Committee has been a diminution in the external beauty of the stern, yet it must be yielded that this is now, precisely as it always has been, a matter of taste; and the stern is susceptible of numerous alterations, as it regards the lighting and ventilation of the accommodation, whilst the principles on which it is constructed remain uninfringed.

That longer guns, or those on Marshall's plan, would have been adapted to the stern of the "Boscawen," without the alterations proposed, may be an assertion not unworthy of consideration. But when the subject was under the consideration of the Committee, their attention was called to the established armament, and the mode of rendering its use efficient, by a suitable alteration of the stern. As the stern was originally constructed, it would be necessary, in order that the right aft guns might run out sufficiently far for the explosion to clear the overhanging of the stern, that those on the gun deck should be twelve feet six inches in length, if on the common carriage (see Figure 12); an increase of weight which would greatly exceed the additional weight of timber that has been objected to. I have not the "Collingwood's" stern to subject to the comparison.

That there is a great "variety of sterns in the navy," and "that scarcely two can be found similar," is a fact, but one with regard to which the respective

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members of the Committee never had any control; and which seems to indicate plainly the desirableness of having either a standard stern, or more definite instructions laid down as a guidance in future constructions. The Committee proposed "that the right aft guns on the two sides of the stern on each deck should cross the fire of each other: that the quarter guns and right aft guns at their greatest angle of training should also cross the fire of each other; and that the quarter gun and the after broadside gun should also cross the fire of each other; so that if possible there may be at the least two guns on each deck made to bear on any one point. That, in addition to these general principles which are laid down for the disposition of the ports, it is most desirable that every gun should be perfectly free from obstructions, and that no part should remain (except the half ports and sashes) to be unfixed when the gun is required for use; that there should be no external obstructions within the influence of the explosion; and that every thing on the outside should be without a cone of 90°, the apex of which being at the mouth of the gun, and the axis being in the line of the bore; or beyond a cone of 40°, which should resolve on a line produced from the bore; this was considered to be without the embrasure which is commonly given in batteries to clear the explosion, and would make the gun perfectly effective." Having then such principles as those laid down as a *sine quâ non* in the construction of sterns, the effectiveness will be ensured; whilst other points of minor importance may be safely left to the taste of the constructor, which might be exercised discretionally in these respects, without imparing the arrangements for offence and defence.

That "the strength of a ship does not depend entirely on her frame, but on the combination of the waterways, shelf pieces, planking externally, &c., which run up diagonally over the timbers," has not been disputed: but though the strength does not depend altogether on the frame, yet this is one of the most material elements of strength in a ship; for its parts may be so disposed that it shall give a very deficient, or an entirely sufficient, degree of strength in relation to the whole mass of timber used, and the construction of the ship. Nor have I the least doubt of the grounds for the statement that neither the strength of the stern of the "Vanguard," nor any of the new sterns, have yet been complained of;" for I am satisfied that they have sufficient strength for all ordinary cases. But the object of the Committee was to give the greatest possible amount of strength that the quantity of materials entering into the construction of the stern would supply; thus rendering it sufficiently strong for extreme cases, as when it is necessary to fight the stern guns for a long time in a heavy sea.

Stern.

With reference to the two models of sterns, which are intended to be laid before their Lordships for inspection, I beg to submit, that I consider it very questionable whether any conclusion respecting the relative strength of the two sterns, and their capabilities for working the guns, can be drawn from the inspection of models on so small a scale, with any degree of satisfaction comparable to what might be realized by inspecting the accompanying Drawings and Diagrams, in which all the parts of disputed efficiency are clearly delineated. And, on the whole, my professional experience does not warrant me to express an opinion concurrent with that of the Surveyor in relation to the two forms of stern.

The "Trafalgar," when launched, swam five feet by the stern, owing to the quantity and gravity of the timber of which her stern is composed, having few openings for light and air in her cabins, besides having a sham external, which must be removed to caulk the ship; and some of the ports are rendered useless, being masqued thereby. The ground of objection arising out of the difference of draught of water, can have no relation whatever to the plans of the Committee, as they were decidedly opposed to any false stern being brought on, as in the "Trafalgar," which doubtless contributed to the depression of the stern. In fact, the Committee were opposed to all projections which would prove an obstruction to any of the necessary workings of the guns.

Bow.

On reconsidering the Committee's bow in connection with the Surveyor's remarks thereon, viz., that "there is such a variety of bows in the navy, that I am at a loss to find data on which to form a comparison," I observe, that this appears to show the same necessity for a standard bow as has been shown for a standard stern, especially with regard to the number and disposition of the guns. Similar conditions might very properly be made for arming the bow as for arming the stern; and whilst these conditions are constantly observed in construction, I can see no reason for imposing any restraint on the taste and ingenuity of constructors on points irrespective of the effectiveness of the armament. The necessity "to have ports in every direction, in order that the guns may be moved from one to the other, as the direction of the object fired at changes," is recognised; and every attention was paid by the Committee to secure this object: and, it is added, "I can discover no reason for placing ports at a greater distance apart, as they will most probably never be worked or fired simultaneously." The design contemplated by the Committee was, that the greatest possible number of guns might be made to bear on the same object—a result which seems so obviously desirable, as almost to preclude the possibility of a ground of objection. The plain

Bow.

"reason for placing the ports at a greater distance apart" was, that at least two guns on each deck might always be made to bear on any object. (See forecastle of a large class frigate, Figure 13.) The supposition that the guns in the bow "may never be worked or fired simultaneously," is no argument in the question; since every officer would feel it his duty to bring the greatest number of guns into effective operation against an enemy, that could be brought to bear on any point in which he might appear.

Frame.

The great quantity of timber required for the frame of a ship, and the difficulty of procuring timber possessing the variety of curves which are necessary to enter into the form, have rendered this part of construction one of the greatest importance; and hence ship builders have, at different times, endeavoured to alter the shift of timber in such a manner as to diminish this difficulty. When Mr. Canham, the late Master Shipwright of Woolwich, was an assistant at Portsmouth, about forty years ago, he proposed that there should be three timbers between the heads and heels, which he considered would afford greater strength than the arrangement then observed, varying the shift suitably to this arrangement, with a view to lessen the difficulties of the conversion of the timbers; but it appears that his proposal was not favourably entertained by the Board at that time. And, in respect of this method of framing, the Committee appear to have held similar views to those which were entertained by the persons in power, both at the time this proposal was originally made, and subsequent thereto. Sir Robert Seppings had the same object in view in proposing the small timber frame, which gave the timber less siding, by having three timbers in each assemblage; but experience soon convinced him that the old sidings, with one between, was superior to that which he had endeavoured to introduce; and all the alteration he ultimately retained was, that of shortening the timbers to a minimum, preserving the square heads and heels, supported by a coke. Whilst the Committee were engaged on this point, they had under their consideration all the plans that have been acted on within the present century; and after maturely weighing the comparative advantages of each system, they came to the conclusion, that each of them was subject to imperfections, which might be obviated by the system of framing which they then proposed should be adopted. Their plan had especial reference to the requisite strength of the frame, and to the convenience of procuring suitable timber; and, whilst it required, as an essential condition, that the timbers should overlaunch each other to such a length as would ensure the necessary degree of strength, it gave the greatest latitude possible to the

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convertor in the section, so that the least expensive timber might be appropriated, without subjecting the frame to any deficiency of strength; since they merely stipulated, that as a minimum, the timbers amidships in ships of the line and large frigates, should have six feet shift and one timber between, giving an increase of strength by a longer shift in the parts where the timbers would have but little curve, and in which they were subject to the greatest force of action, as may be seen on inspecting the Drawings submitted by them. On referring to the Report of Mr. Hawkes, dated May 1836, in which he compares the frames of the "Clarence" and the "Vanguard," the Surveyor grounds "an opinion that the shift of frame adopted in the Service is superior to the one recommended" by the Committee. But upon an attentive perusal of this Report, I cannot find that it supplies any evidence which would assist us in forming a just conclusion of the relative merits of the two frames now subject to eqnuiry: for, in this Report, Mr. Hawkes appears to have principally in view the difference of expense incident to the *forms* of two ships; as in reference to a table he had given, showing the comparative expense of the ships therein named, he remarks, that he "made the above statement in order to show the falsehood of the assertion made by parties on that subject, wherein they state that the *form* of the 'Vanguard' is calculated to consume a very much greater quantity of timber than the *form* of the 'Clarence,' which assertion," he says, "*I positively deny.*" But if a comparison of different shifts of timber in two ships be made in order to arrive at a just conclusion with regard to their relative advantages, it seems obvious, that a principal condition to be observed should be, a *similarity of form* in the two ships; but this is so far from being the case in this comparison, that reference is had particularly to the *difference of form,* as the ground of superiority. In the latter part of his Report, however, Mr. Hawkes institutes a comparison of two frames in relation to their shift; and this comparison might have reference to the old plan of framing ships in respect of shift, but it can have no just reference to the plan proposed by the Committee. It appears to me extremely difficult to judge whether the small difference of expense arose from the disparity in the forms of the ship, or from the difference in the disposition of the timbers. And, upon the whole, the statements made in this Report are so obscure and inconclusive, that I am not able to deduce any useful inferences from them with regard to the framing of ships. This will be evident on endeavouring to compare the quantities of the different kinds of timber used in the three ships. The English timber appears to be given in the rough (or, it may be, sided) state, without any showing of

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the manner in which the small and petty conversions were brought to account; and there is likewise a great difference in the quantity of Italian timber used in the "Vanguard" and "Collingwood," which is admitted by Mr. Hawkes to be particularly well adapted for constructing the frames of ships.

In the remarks annexed to Mr. Hawkes's Report it is stated, that "the butts of the old shift are used in *one* continuous line, which shews its weakness; and it is known that ships have separated at the floor heads when taking the ground, and this is the cause also of their being bilged; while the new shift gives three whole timbers between the two butts, and of course twice the strength." But it is here omitted to be shown that it is not practicable to have three timbers between the two butts, without shortening the shift to about three feet in the frame, and filling frames in conjunction.

The observations contained in the above quotation are quite at variance with experience. At the present time, more than five-sixths of the ships composing the British Navy, have only one timber between each head and heel; and as a great number of these ships have been many years at sea, it can scarcely be a subject of doubt, that in the number of years they have been employed in active service, some of them must have been ashore; and yet I think it may be affirmed with the greatest confidence, that it would not be possible to find a single timber in any of them broken for want of due strength. Nor do I know of a solitary instance in which a ship, properly built, has separated at the floor heads, except when, by beating upon the rocks, she has been acted on by force capable of destroying the fabric altogether, however strong it might have been made, and which would, of course, bilge the ship. I have, indeed, known one or two instances in which timbers have been broken; but, on investigation, they were found to be broken in such parts, that I do not think the damage could be justly regarded as the consequence of a deficiency of strength arising from having only one timber between. But even should there be any ground to attribute the effect to such a cause, they would not bear a comparison with the present ships, to which an increase of strength is given by filling in the openings in the frame. Nor is there any increase of strength supplied by having three timbers between the heads and heels, since in that case the shifts can be only half the length, in consequence of which every alternate frame must have this short shift (see Figure 14). It is not the consequence of a deficiency of strength in the frame that the effects of the working of a ship sometimes become visible, but of a small yielding in parts shown by the variation of the angles formed by the side of the ship and the beams, which change in the alternate

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rolling of the ship, an effect which the shortening of the shift of timbers in the frame would increase. If the strength depended on the number of timbers between each head and heel, six might be obtained as well as three; but then, instead of six feet, as proposed by the Committee, the shift would be only eighteen inches. This shortening of the shift, however, brings a general weakness, and it must subject the ship to the greater consequences of working: whereas the experience of many years bears ample witness to the advantage of a long shift and one timber between. If the timbers have the proper shift to prevent working, the strength of the frame, viewed in connection with the support it receives from a combination with the different parts of the structure, will be found to exceed what is actually required for the stresses to which it is subject. This is evident from the fact that decay has in many instances entered into the frame, without impairing, in any visible degree, the strength of the ship; and the excess of timber that is used in the frames can be considered necessary only as it gives solidity to the structure, and provides against a partial decay without a material loss of strength.

In the remarks annexed to Mr. Hawkes's Report it is stated, that "if the old method had been continued, the frames of the three 90-gun ships at Plymouth, two 80-gun ships at Chatham, the 90 and 110 at Portsmouth, with three 80-gun ships at Pembroke, would not have been provided in a space of less than two years from the stores of the Yards, which I attribute entirely to this new shift of frame." If such delay had been incontestably shown to be incident to the providing of frame timber under the old system, I am utterly at a loss to conceive on what ground the difficulty would have been more easily surmounted under the new system, since the description of timber answerable to them both, differs so little as to render any advantage of the new system over the old, in point of time, highly improbable. Even if the statement in the above quotation were pertinent to the two systems of which it is made, it would be totally inapplicable to that of the Committee, in which no restriction is enforced on the convertor, beyond the necessity of providing timber to give sufficient strength. In what way the little difference shown in the variety of the lengths and curvature obtained by introducing a different shift to the frames and filling frames, can determine the relative merits of the two plans, I have been unable to discover. Indeed, the following Table, in which the actual variety of lengths and curvatures is shown, does not lead to any such inference. The "old plan" would have the variety as shown by the assemblages called *frames* and in the new plan, the variety would be according to the assemblages distinguished as

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frame and filling frame combined (see Figure 15). I am not aware that the convertor was ever required to adhere so closely to the disposition of the heads and heels, that he might not occasionally vary, to a small extent, the position of a butt, on finding that the timber would not run the proper length, making up the deficiency by the timber either above or below. And it will be seen, on referring to the Table, that they are not "so very nearly of the same length as to render it impossible to procure so many pieces of timber of suitable lengths that will convert advantageously, however great the store," is an assertion without any foundation in reality.

Comparative Lengths and Curvature of Timber, according to the Form and Shift of Timber of the "Mars" *and* "Monarch."

Description of Timbers.	Number of Timbers.	According to the Form and Shift of the "Mars."		Number of Timbers.	According to the Form and Shift of the "Monarch."	
		Length.	Curvature.		Length.	Curvature.
		Ft. In. Ft. In.	Ft. In. Ft. In.		Ft. In. Ft. In.	Ft. In. Ft. In.
Cross Floors, Frame	26	9 6 to 14 0	1 10 to 3 6	58	7 0 to 18 0	0 10 to 3 0
Half Floors ditto	50	12 0 „ 16 0	0 1 „ 0 9	58	10 0 „ 15 2	0 6 „ 0 9
Long and Short Arm Floors, Filling	50	11 0 „ 15 9	1 8 „ 3 0	..	.. ..	.. ..
Double Futtocks, Frame	20	17 6 „ 19 3	0 2 „ 1 4	34	13 3 „ 18 0	0 3 „ 2 3
Double Filling ditto	20	16 6 „ 20 4	0 1 „ 1 9	..	.. ..	.. ..
First Futtock ditto	70	11 9 „ 16 0	0 1 „ 0 8	142	9 0 „ 13 6	0 3 „ 1 2
First Filling ditto	66	11 3 „ 15 3	0 1 „ 0 10	..	.. ..	.. ..
Second Futtock ditto	68	13 2 „ 13 9	0 3 „ 1 0	116	10 6 „ 11 0	0 1 „ 0 10
Secoud Filling ditto	56	13 2 „ 14 7	0 1 „ 0 11	..	.. ..	.. ..
Third Frame	70	9 9 „ 12 9	0 2 „ 1 2	142	9 8 „ 12 2	0 3 „ 0 10
Third Filling Frame	66	9 9 „ 13 4	0 2 „ 1 0½	..	.. ..	.. ..
Fourh Frame	66	9 2 „ 12 3	0 3 „ 1 4	142	10 3 „ 12 3	0 3 „ 1 0
Fourth Filling Frame	66	9 6 „ 11 9	0 2 „ 1 1	..	.. ..	.. ..
Fifth Frame	38	10 0 „ 13 9	0 4 „ 1 4	72	9 6 „ 12 10	0 5 „ 1 10
Fifth Filling Frame	66	9 6 „ 15 3	0 4 „ 2 0	36	12 0 „ 16 6	0 8 „ 2 6
Sixth Frame	Short	.. ..	.. ..	36	12 0 „ 14 0	0 2 „ 1 0
Sixth Filling Frame	64	10 6 „ 18 0	0 4 „ 1 6	72	16 0 „ 18 0	0 3 „ 1 0
	862			908		

The short timbers over and under the ports, and short topsides, are not included in this Table, as they do not affect the comparison.

Nor can I find, even in taking the old form of ship, and the old method of shifting the frame, as

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the "Monarch," built in this Yard (Chatham), and comparing her form and shift with the new form and shift, as those of the "Mars," and "Majestic," that there is any ground for the assertion "that the shift of frame adopted in the Service is superior" to the one recommended by the Committee (see Table below), which approaches very nearly to the frame of the "Monarch;" only that they merely stipulated for the requisite degree of strength, and name that as a minimum, the timbers should have six feet shift, shortening gradually to five feet towards the extremities. And with a view of further aiding in the conversion of the frames, several plans were given for making floors, to be used discretionally, and as the convertors might find most desirable from the suitableness of the timber in the Yard.

Comparative Lengths and Curvature of Timber, according to the Committee's Plan, as "Mars" *and* "Monarch," *as alluded to by the Surveyor, taking the Form of the* "Mars" *in both cases.*

Description of Timbers.	Number of Timbers.	Shift of Timber, Surveyor (as "Mars.")		Number of Timbers.	"Mars's" Form, with Committee's (as "Monarch's") Shift of Timber.	
		Length.	Curvature.		Length.	Curvature.
		Ft. In. Ft. In.	Ft. In. Ft. In.		Ft. In. Ft. In.	Ft. In. Ft. In.
Cross Floors	26	9 6 to 14 0	1 10 to 3 6	58	9 0 to 16 4	2 3 to 3 4
Half Floors	50	12 0 „ 16 0	0 1 „ 0 9	58	10 0 „ 15 0	0 3 „ 0 8
Long and Short Arm Floors . .	50	11 0 „ 15 9	1 8 „ 3 0	..	.. ..	.. ..
Double Futtocks	40	16 6 „ 20 4	0 1 „ 1 9	34	19 0 „ 19 6	0 2 „ 1 6
First ditto	136	11 3 „ 16 0	0 1 „ 0 10	142	10 2 „ 14 6	0 1 „ 0 10
Second ditto	124	13 2 „ 14 7	0 1 „ 1 0	116	10 7 „ 11 3	0 1 „ 0 6
Third ditto	136	9 9 „ 13 4	0 2 „ 1 2	142	9 9 „ 12 3	0 2 „ 1 0
Fourth ditto	132	9 2 „ 12 3	0 2 „ 1 4	142	10 4 „ 12 6	0 1 „ 1 2
Fifth	104	9 6 „ 15 3	0 4 „ 2 0	108	10 0 „ 17 0	0 4 „ 2 3
Sixth	64	10 6 „ 18 0	0 4 „ 1 6	108	12 0 „ 18 0	0 4 „ 1 0
	862			908		

The short timbers under and over the ports, as well as the short top timbers, are not included in this Table, as they do not affect the comparison.

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One great objection to the "half shift" is, that should a great stress be brought upon the part embraced within the red circle (Figure 16), there would, very probably, be a deficiency of strength to resist it; and on the heads and heels being forced in by external pressure, there would be a greater tendency in the timbers to break, than if the shift were six feet (that is, double the length of the "half shift,") with one timber between.

I have carefully examined the Reports of the Officers of the several Dock Yards, on the filling in of the opening between the timbers of the frame, as referred to by the Surveyor, in support of the plans now in use; but can gather no motives from them to alter my opinion on this subject. But my reasons for maintaining a preference to the plan proposed by the Committee are founded on what I firmly believe to be important advantages to the Service: the solid fillings in of the openings render the bottom of a ship more secure in the event of disaster; they prevent decay, by excluding the impure air from the sides of the timbers; they have a tendency to preserve the health of the crew, by preventing an accumulation of filth in those spaces, which, on decomposition, generates miasma and noxious vapours; and they increase the strength of the ship, especially longitudinally. That they render the bottom more secure is self-evident; for though it is not common that the planking of the bottom, by any disaster, becomes injured much above the bilge, yet if the fillings were not carried up, the water would find an earlier passage into the ship over the heads of the fillings; but by bolting the lower or upper edge of the strake of the bottom, just below the head of the fillings, and caulking it between the plank and the timbers, before the plank below or above it is brought on, the bottom is rendered quite secure from the annoyance of any leak that might take place below the heads of the fillings, or the strake brought on just below them. Notwithstanding the strictest attention and vigilance that can be exercised, small leaks will frequently occur at the fastenings of the planking of the bottom, the mischievous consequences of which the fillings may be made to prevent. That they prevent decay by excluding foul air from the sides of the timbers, we have the evidence of experience to verify; as, during the survey of the fleet, when the fillings were cut out, there were comparatively few instances in which the sides of the timbers were defective, especially where the fillings were of solid wood, or cement mixed with tar; and though there were more defects where the cement was mixed with water alone, yet even these were not so numerous as was apprehended. With regard to the accumulation of filth, I have to remark, that after all possible care has been taken to prevent such a nuisance, it is found, on repairing ships, or breaking them up, that

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unless the openings are filled in with some solid material, the spaces are full of filth, which cannot fail, in the various changes of temperature to which it is subject, to emit a noisome vapour, which, though it may be, and doubtless often is, unperceived from any immediate consequences, cannot be otherwise than highly injurious to all who live within its influence. Not only are such collections insalubrious to the crew, but they have a direct tendency to produce decay; and I have known a fore step to have become entirely rotten in three years from this cause. From these considerations, therefore, it appears important that there should be as few apertures as possible in which filth may accumulate.

That the fillings increase the strength of a ship, will, I think, be clearly perceived on a little consideration. The structure should be such as to offer the greatest possible resistance to an alteration in the form by extension and compression, since the materials of which a ship is composed are not sufficiently elastic to react with the same force that acts externally to produce such alteration. When, therefore, the entire stress, tending to produce compression, acts upon the fastenings in the bottom, and this stress is greater than the resistance supplied by the fastenings, the compactness of the structure must necessarily be impaired, and it hence becomes less capable of resisting the forces which may subsequently act upon it. The firmness of the body, produced originally by the fastenings, having yielded to external force, a movement or working takes place amongst the parts, which increases as its own effect is to diminish the resistance. This was particularly evident in the butts of the plank at the lower part of the body, and the fastenings in the sheer strakes above, previously to the openings being filled in at all. Now, as the shelf pieces, from their great substance, and situation at the upper part of the structure, in connection with the exterior and interior planking, form longitudinal ties which supply a great resistance to extension; so do the fillings in the lower part of the bottom, by their solidity, supply a powerful resistance to compression. Before the body can deflect, or what is technically called break the sheer, an extension must take place above a certain point within the body, and a compression below it; and this point is called the neutral axis, or point of revolution. The body will, therefore, deflect according as the parts above are extensible and the parts below compressible; and the neutral point will be raised or lowered in proportion as the resistance to extension or compression is greater. Now to such an extent as the openings between the timbers are filled in with solid materials, so is the resistance to compression increased; when, therefore, these spaces are completely filled in, the body is rendered as incompressible as the nature of the substance of which it

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is composed will permit, and the resistance which the same surface opposes to compression is greatly increased; hence the neutral axis must be lowered in order to equalize the moments of extension and compression round that line. And since the resistance to deflection varies as twice the moment of the resistance to extension, in each case the resistance to arching will be increased. This may be inferred from natural principles: for after the ship has assumed a curved form, there is an equilibrium round the neutral point; therefore the force which will prevent extension is equal to the force which will prevent compression; and the sum of these two, or twice the force that will prevent extension, since they are both equal, is the resistance to arching.

I have also to observe, that the Committee have provided for the water-courses, as mentioned in some of the Reports, by keeping the fillings at a suitable distance within the inner surface of the timbers; and they have likewise very much diminished the trouble of fitting them by avoiding the rabbet, and having them in one thickness, as by this alteration both labour and materials are saved.

I have now, on this part of the subject, only to remark, that the diversity of opinions expressed in the several Reports, renders those documents, as a body of evidence, most unsatisfactory; whilst my own observation assures me that some of the statements they contain are not in accordance with the experience of the British Navy.

On Scarphing the Beams.

Upon a reconsideration of the scarphing of the beams, in connection with the Report of the Officers of Portsmouth Yard, I have to state, that I do not see any very cogent reasons for giving a decided preference to either of the plans; for I believe they may both be made sufficiently strong. Still I cannot but consider that the Committee's plan would be attended with less of both trouble and expense in putting them together. But the expenses stated in the note to the Portsmouth Officers' Report, relate to a comparison with the old plan, and not to that proposed by the Committee. If the scarphs of the present plan should be preserved, I am of opinion that they should be extended to the length proposed by the Committee; since they now assimilate too much to the French tabling, according to which the beams were frequently found weak in the quarters.

I see no particular objection to the recommendation of the Surveyor, that the half beams should be from sixteen to twenty inches apart, with thicker decks; although it must be highly desirable, with the heavy metal that is now carried, especially carriage guns, to give ample firmness to the decks, to prevent their becoming leaky; I think, therefore, that sixteen inches in the clear is not too little.

Knees.

The forked knees, to which the Surveyor gives the preference, have doubtless a great degree of

Knees.

strength; and yet the employment of such knees appears to be applying strength in a manner less serviceable than it might be applied, with a great superfluity of weight; for, on referring to Figure 17, it will be seen that the two forks or arms serve no other purpose than that of receiving one or two fore-and-aft bolts; and that these bolts are in a situation in which they are not liable to be acted on. That the beam ends should have a most substantial connection with the sides of the ship, appears very important; since the transverse strength of the ship, and consequently her general security, in a great measure depends upon the firmness of this combination, which has to sustain the whole working of the side when she is acted on by the weights she contains, and by the pressure of the wind and the sea. When the ship is under a press of sail, in a heavy sea which produces a rolling, the angles which the beams form with the sides are continually varying: this cannot be altogether prevented; it is therefore necessary, in forming the connection, that the fastenings should be so disposed, that while they preserve the compactness, they should not, when this variation of the angle takes place, have a tendency to separate the beams from the side. To produce this effect then, the bolt fastenings should be so placed, that the force which is brought upon them shall act in the direction of their length; for where great force acts upon bolts transversely, the firmness of the combination is liable to be destroyed by the forces which produce a working of the parts which they unite. Now the plan proposed by the Committee was, to have two up-and-down bolts passing through the beam, and ears formed close to the shelf on the beam arm of the knee; and to have its principal connection with the side formed as near as practicable to the lower side of the beam, by two bolts passing through the side of the ship, the shelf-piece, and ears formed on the side arm of the knee to receive them. These bolts passing through the beam and side close to the angle of the knee, in connection with the up-and-down bolt that passes through the waterways, beam, and shelf-piece, and the coaks at the upper and lower sides of the beam, which increase the compactness of this combination, form an effectual resistance to the forces to which reference has been made.

When these forces produce a working of the ends of the beams with the side of the ship, the action at the alternate rollings is upon the outer and inner parts of the shelf-piece, and the inner part of the waterways, as denoted by the dotted lines (Figure 17), according as the motion of the ship tends to raise or depress the beam. The action of the beam is, therefore, resisted by the outer and inner parts of the shelf-piece, and the inner part of the waterways. Then obviously the neutral point is intermediate between those two points of resistance. And yet, *Knees.*

in the line between these points of resistance, where no force can be exerted, the bolts are passed through the beam to hold the cumbrous arms of the forked knee. But even if they had been subject to any force, that force acting on these bolts transversely would tend to open the wood, and form a free space for their action; and when such an effect had been produced, the arms and bolts would no longer maintain the compactness of the combination. Since, therefore, the knee proposed by the Committee supplies a resistance adequate to all the forces that are brought upon it, and is considerably less expensive, both in material and labour than the forked knee, I cannot but give a decided preference to it.

Iron Riders.

In opposing the iron riders proposed by the Committee, on the ground of their adding "much to the smiths' work without an equivalent," the Surveyor appears to have overlooked two points connected with the subject; first, that by the Committee's plan there is a great reduction in the quantity of iron work; and secondly, the trouble incident to the performing of any casual repairs when the riders are let into the timbers. The Committee's plan was designed to increase the firmness of the combination of the heads and heels of the timbers by ears and bolts at their abutments; still the quantity of iron required for their system is little more than two-thirds of the quantity used in the present system of riders; as in their system there is only one tier of plates, which are brought on at the inside of the planking; but in the present plan there are, in addition to those brought on the inner surface of the planking, rider plates let into the timbers. Now by the direction of the second tier of plates, their passing behind the shelf-pieces and principal strakes, and their being let into the timbers, no part of a defective timber can be shifted, without either cutting off the plates, or removing the shelf-pieces and planking to take them out. If, therefore, these plates were originally necessary, the effect of cutting them off for such repair must evidently be a deterioration of the ship, since the same support cannot be replaced without removing the shelf-pieces and principal strakes, which would involve a great amount of labour. This is not a question of opinion, but a fact verified by practice in carrying on repairs; whilst the plate proposed by the Committee can easily be removed for such purposes.

If the plates as they are now let into the timbers be regarded, in connection with the plate riders used at the inside of the inner planking as giving support transversely, it may be observed, that when any pressure is brought upon the side, the centre of motion is either on the outer side of the outer planking, or on the inside of the inner planking, according as the pressure acts externally or internally; and in either of these cases the force has a tendency to separate the seams. The two riders being, therefore, at unequal distances from the centre of motion,

Iron Riders.

cannot be alike acted on by the same force; hence one of them is useless; and the rider which is farthest from the neutral point would, of course, be acted on most powerfully; this rider is at the inside of the inner planking, as the Committee proposed, and is, I believe, quite sufficient for all the purposes for which a rider is required. And this sufficiency appears to be satisfactorily attested in the case of the large frigates which have only one set of rider plates on the inside of the planking, where alone they appear to be required. If it be contended that these riders increase the longitudinal strength of a ship, it may be stated, that, in this respect, they act by extension only in the same way as those proposed by the Committee. When these riders are viewed in connection with the great mass of materials of which a ship is formed, which are opposing the forces, both to extension and compression—those to compression by the whole mass of timber at the lower part; and to extension by the whole of the planking above the neutral axis, with the shelf-pieces, waterways, &c., and with all the strakes acting edge to edge brought into close contact by the caulking to prevent the ship's arching—it can never be justly supposed that much additional support is afforded by the riders. But even should they be brought into action by extension, since most of them pass over curved surfaces the result of this force would be to diminish the curve of the side, provided they were of sufficient strength, and the fastening held good. On these grounds, in connection with those already mentioned with regard to the repairs of the ship, I am bound to give a decided preference to the riders proposed by the Committee, both on the score of economy, and their sufficiency for the required purposes.

Iron Hooks and Crutches.

As it regards the crutches and hooks, the use of which the Surveyor says "has been long the practice in new ships, and should be continued generally," I have to remark, that the only aim of the Committee was, to combine the two sides more firmly, which I believe this plan will effect.

Fastening of Planking.

In reference to the Surveyor's remarks, that he is "strongly opposed to the use of treenails," and that "bolt nails are much superior, and great improvement would be accomplished if they were general,' I observe that, at the present day, it is not a matter of opinion, but a subject on which long and universal experience has decided. The oldest ships on which I have had an opportunity of making observations were treenail fastened, as were also by far the greater proportion of British ships-of-war, during the long wars at the close of the last and the early part of the present century. And I have never seen any deficiency of strength as the consequence of using treenails, when they had been properly and judiciously employed; but I have seen treenails

Fastening of Planking.

perfectly sound, and their security good, after having been in forty or fifty years. Instances might be cited, in which defects from the use of treenails have been fully manifest; but these defects were generally the consequence either of the badness of the treenails, or of their being improperly driven; and, latterly, it may very probably be the result of the unsuitableness of the timber used for treenails. But these facts cannot impeach the principle, provided due care be observed in applying it. It has been the case, that a partial use of bolt nails has been introduced into ships; and, in some instances, metallic fastenings have been exclusively employed; but I have always considered this alteration to be destitute of any improvement, either as to economy or advantage to the ship. It may be admitted, that bolt fastenings have a preference when great dispatch is required; but on no other consideration. The fastenings of planks on ships' bottoms may be considered requisite for a twofold purpose; first, to combine the planks firmly with the timbers; and, secondly, to resist the force of caulking the seams; and I consider that treenails are best adapted for both these purposes, when there is a sufficient quantity of fastenings to hold the plank close and firmly to the bottom until the treenails are driven: and for this purpose Mr. Blake's screws are fully adequate. I confidently believe that the oldest and the best shipwrights always considered that treenails were indispensable to resist the action of caulking, for which the bolt nail fastenings are not so suitable; and that they would not on any account have consented to give them up. And there is much greater hazard of splitting the timbers in driving these bolts than in driving the treenails. I do not consider it is necessary to use so many treenails as were formerly used, nor to drive them so large. At the same time I cannot approve of the reduction of the scantling, as recommended by the Surveyor, since the great body of timbers in the frame of a ship is not so necessary to give the required strength as to give the solidity and firmness which appear essential in a ship-of-war.

Tables of Dimensions.

The Tables of beams, shelf-pieces, waterways, planking, &c., were well considered by the Committee; and where, from the inefficiency of the old system, or the increased armament lately introduced, it appeared requisite to provide additional strength, such requirement was had special regard to; and upon reflection, I fully approve of the Tables proposed by the Committee.

Breadth of Channels.

The Committee were perfectly aware that the form of the topsides of the old ships would not allow of *their* channels being narrowed, and did not, of course, contemplate such an alteration. Their proposal related to new ships, in the building of which they deemed it important that no external

Breadth of Channels.

obstruction should interfere with any necessary training of the guns; with this view they proposed "that the common form of topsides should be in a line parallel to the shrouds." With this alteration, the channels might be so far narrowed that the guns could be trained two or three points before and abaft the beam, without endangering the shrouds by the explosion. The Surveyor observes that "in all new ships this has been the practice, and the channels are in consequence narrower." I believe this statement is correct to a certain extent, but not to the extent which the Committee considered necessary, and proposed. The relative forms of the old and new sides and channels are shown nearly in Figure 18.

Iron Riders.

On perusing the letter of Mr. Lang, dated the 13th April, 1842, in which he states his objections to sign such part of the Committee's Report as related to the iron plate riders, I have to observe, that his narrative of a steam boat, adduced with a view to prove the efficiency of these riders, is quite irrelevant to the objects contemplated by the Committee. But as Mr. Lang doubtless considered that these statements would form conclusive evidence in support of the plan he advocates, it may not be improper to remark, that the result of mere circumstances can form no satisfactory evidence in the estimation of impartial judges. The narrative details a series of disasters to which the "Lightning" was subject, and her safety in the hazardous trials to which she was exposed; but it cannot be proved that her safety was the result of that system of riders or keel with which she had been built, or of any riders at all, unless other vessels, *in other respects* equally strong, had shown an unfitness to encounter similar trials; nor even then could a single vessel determine the point, unless there were any general principles by which it could be shown why one ship founders at sea, and another ship of similar construction and strength, and corresponding with her in other circumstances, returns safe to port.

Instances of great hazard and equal indemnity might be shown of other vessels, which have had no riders at all, having the openings between the timbers filled in to the floor-heads, and the upper parts held firmly together longitudinally by strong shelf-pieces, waterways, and other thick strakes, which I believe the "Lightning" had in part; but since it requires a generalization of facts to establish any principle, I consider it would be unsound reasoning to conclude from the safety with which a small number of vessels have passed through imminent perils, that their indemnity was the result of any particular combination or form of construction. Such an instance occurred in the late gales of a private steam vessel, built about fifteen years

Iron Riders.

ago. In attempting to rescue ships that had parted in the gale, she was driven across a bar, and was left suspended; in this position she had to endure the violence of the gale, but eventually she came off, and I am not aware that any serious injury was sustained. Many other instances have occurred of steam vessels being driven ashore, and of their sustaining great violence at sea; but as these would not be pertinent to the present inquiry, they need not be detailed: for what may be requisite in the smaller frame of steam vessels would be altogether unnecessary in men-of-war.

Mr. Lang states, that as the other members of the Committee had "never had a fair opportunity of fitting a ship on the proper principles, or proving its merits by actual examination, he cannot allow a mere opinion in direct opposition to many incontrovertible facts to pass unnoticed." This passage contains an unfair statement as to the experience of the other members of the Committee; and the assumption by Mr. Lang of exclusive knowledge on this subject, appears unwarrantable and fallacious. I can speak decidedly for myself, that my judgment was formed on the personal observations I had made upon ships during their repair under my own immediate superintendence, in which the riders and keel, to which he assumes the safety of the steam boat to have been owing, had been employed. Now whatever violence the "Lightning" may have encountered and survived, it is no "incontrovertible fact" whatever that her safety was owing to the causes to which it has been ascribed, since her frame at the lower part was a solid mass of timber, and her scantlings and openings between the timbers were much less than I have seen in steam vessels of much larger tonnage, which were without either the safety keel or the iron plates. And yet these steam vessels have sustained extreme violence at sea, and have lain on shore with their engines and boilers on board, without requiring to be docked for repairs during several years.

But the Committee's attention was never called to the building of steam boats; their plans were, therefore, formed with the design of being adapted to ships-of-war. However, since Mr. Lang brings forward the "Trafalgar" as an illustration of what he considers the advantage a ship derives from the iron plates, it may be proper to make a few remarks on her general construction. The scheme of scantling for the "Trafalgar" was the same as that for other ships of the same class at the time she was laid down, but the dimensions of the timber of which she was actually built vary from the original specifications in some of the most material parts which relate to longitudinal strength. For instance, the shelf-pieces and strakes under them are much larger than they are in any other ship of the same

Iron Riders.

class that has been built, which greatly increases the resistance to extension; whilst the addition of lateral power thus supplied, connected with the increased force just mentioned, presents a much greater resistance to arching. These are not the only parts in which considerable increase of dimension has been given to timber, and alteration in the position of the parts. Yet I would not attribute the small break of her sheer altogether to this cause, since there were others which contributed mainly to diminish that break: the number of years she had been on the stocks allowed the timber to become unusually dry, and in that state the caulking of the seams produced a more than ordinary degree of compactness in the fillings between the timbers, the whole of the external and most of the internal planking, which consequently presented a greater resistance to arching, while the force to produce which was considerably diminished by the lightness of the timber, which was the result of its dryness, and the lightness of the ship, owing to her having scarcely any of her internal fittings on board at the time she was launched. Here are now several important circumstances in which the "Trafalgar" differed from other ships, quite distinct from her riders and keel, none of which have been taken into the account by Mr. Lang, who endeavours to show that the effect was owing to a cause apparently very inadequate. And it must be clear from this statement, that she does not form a fit subject of comparison with any other ship in the Navy, in such a way as would lead to any just conclusions as to the utility of the iron riders and keel.

Mr. Lang states, that as the riders proposed by the Committee "terminate at the under side of the lower deck, and the heavy weight of guns above, on the side of the ship commencing at this place, there will be the hinge for the working of the ship;" and he adds, that his "judgment is established by a long and most careful consideration, grounded on incontrovertible facts." Whatever may have been the character of Mr. Lang's observations, it does not appear that he has taken any particular pains to investigate the relations of cause and effect; or to ascertain the relative powers of resistance and stiffness of the materials used in a ship. For it is a point easily determined by experiment, that a single oak timber in the parts which he supposes to be weak, with more than the weight of three guns, would not deflect three-eighths of an inch; whilst the iron plate rider in which he places so much confidence, would deflect six times as much, with less than one-sixtieth of the weight; and its elasticity would not restore it. There is now only one of these riders between two ports, and in the same space there are six timbers. And when it is considered that these timbers receive the combined

Iron Riders.

and continuous support of the shelf-pieces and waterways, both above and below, and that they are firmly connected with the external and internal planking, the comparative support afforded by these riders sinks inconceivably beneath anything that is ever estimated in construction.

The use of iron in ships is necessary chiefly where it is employed as a tie; but when it is used with a view to increase the lateral resistance, it should be observed, that its elasticity is too small to recover it from any deflection to which it becomes subject in connection with the more elastic timber. These were the views I entertained when the subject was under the deliberation of the Committee; nor did the riders appear necessary for any other purpose than that of bringing into one compact body the three substances of timber which form the side of ship, viz. the external and internal planking and the timbers (see Figure 19).

The shrinkage and splitting of the planks are complained of by Mr. Lang in connection with the riders placed upon them; and in consequence of this shrinkage and splitting, he objects to their being externally applied. It is well known that the shrinkage of timber is a great practical evil in shipbuilding, which we have no means of completely remedying. But should any shrinkage take place beneath the iron riders, and it thereby becomes necessary to resolve the compactness, this may certainly be done with far less trouble when the plates are applied externally, than when they are let in between the timbers and the internal planking; as to restore the compactness on the Committee's plan all that would be required is, to set the riders and planking to, and reclench the bolts, or to fir them up where they could not be drawn together, for neither of which operations would it be necessary to displace any of the internal parts; whereas, all the internal planking, shelf-pieces, waterways, &c., must be removed in order to remedy the effects of any shrinkage, or other defects, when the riders are let into the timbers. But shrinkage and splitting are not defects that I considered it necessary to estimate; and in this I am borne out by facts ascertained on the examination of several ships, one of which is a 50-gun frigate more than twenty years old, and has been much in active service, in which the plate riders lie in part over the inner planking, but which has no appearance of either shrinking or splitting having taken place. Nor do I suppose Mr. Lang could have had this in view when he applied so much ironwork over the planking of the "Trafalgar," in which the whole of the iron knees, transoms, &c., are subject to the same objection.

Keel.

When the form of keel was deliberated on by the Committee, I considered I had substantial reason for preferring that which was decided on, the con-

Keel.

struction of which is far less expensive, and the repair of any injury that occurs to it is less troublesome and expensive than that proposed by Mr. Lang; the enormous trouble and expense incident to which do not appear to be compensated by any proportionate advantages. The original superfluity of expense incident to this "safety keel," as it is called, is occasioned by having several additional strakes, some of which require pieces of timber suitable to a common keel; the peculiar manner in which the vast quantity of timber that is employed is bolted together, renders it very difficult to perform such repair, so difficult indeed, that it is often impracticable to drive out the bolts, when the strakes are therefore required to be spilt out. And from the experience I have had, I believe it would be extremely difficult, if not impossible, to repair the injuries that would be likely to occur in a time of war, owing to the great labour and length of time required for making good such damage.

Whatever necessity there might have been, previously to the openings between the timbers being filled in with solid materials, for some further security at the lower part of the ship, is not now a subject of enquiry; but since the timbers from the inside of the garboard strake up to the cutting down of the floors and upper surface of the timbers of the frame, have been made a solid mass, and are well caulked, and offer as effectual resistance to the admission of water as the safety keel can offer, there does not appear to be any additional security afforded by the immense mass of timber and increased labour required in forming this keel. The sufficiency of the timbers to afford security to the ship has been practically determined by repeated instances of ships having carried away their keels, and which have yet arrived safe in port after such damage; and I remember one ship which came in this condition, I believe from the West Indies, in the early part of the last war; though the fillings of this ship extended no higher than the floor heads. If then a ship so built was capable of performing such a voyage as this in safety, after the loss of her keel, there cannot be a rational doubt that the greater safety of the bottoms, by a much closer and firmer combination of the timbers, that has been since introduced, supersedes the necessity of any such expensive mode as Mr. Lang proposes for protecting the bottoms of ships,—viz., that of removing one solid mass of timber that has been proved in numerous instances to be sufficient for all that is required of it, merely to supply in its place another solid mass, less easy of construction and repair. And since it is clearly incumbent on the naval architect to form and connect the several parts of ships in such a way that the repairs of damage to which they are most commonly liable may not be obstructed

Keel.

by any unnecessary difficulties arising from the combination of their parts, whilst the security of the fabric is ensured, I consider the difficulty of repair incident to Mr. Lang's keel one decided objection to its adoption in ships-of-war; and I am of opinion that the improvements proposed by the Committee answer all the requirements of the Navy.

I trust their Lordships will consider the detailed answer to Mr. Lang's letter a sufficient reply to the Surveyor's remarks on that letter, so far as it relates to the riders and garboard strakes. But with respect to the keel, the original "mode of fitting" which the Surveyor ascribes to "Mr. J. Peake, in 1791," I remark, that the requirements of the Navy at that time, and for many years subsequent thereto during which, the most experienced ship-building officers were at the Board, render it presumptive, that if its intrinsic merits had been such as to prove it worthy of attention, and there had existed any occasion for such a contrivance, some satisfactory trial would have been made of it.

I have thus endeavoured to comply with the instructions contained in Sir John Barrow's letter; and have, I trust, given my reasons explicitly for supporting in Committee the several alterations of which the Surveyor has disputed the propriety. The strict regard to the interests of the Service, and the great importance of the subjects on which the Committee were directed to consult, which actuated me, in connection with the other Master Shipwrights, have been maintained in making a deliberate and careful review of the points so disputed. And the determination of my judgment has been in strict accordance with the best information that long experience and rigid observation and enquiry have enabled me to obtain.

I have, &c.

(*Signed*) JOHN FINCHAM.

P.S. As I am not in possession of the Drawings made by the Committee, it is probable that some of the Figures given as illustrations in this Report may not be perfectly accurate; but I believe they are sufficiently correct to illustrate the principles in reference to which they are given.

J. F.

From Mr. J. ATKINS, *Sheerness Dock Yard.*

Surveyor.	13*th February*, 1843.
The doing away with the quarter port, on the point of impunity, is a great sacrifice.	By dispensing with this port, it affords a greater latitude for disposing the other quarter and right-aft ports to advantage, both with regard to training and cross firing. In the stern constructed by the Committee, there are two guns that can be brought to bear on every point, so that there can be no necessity of having recourse to making a port of the quarter gallery door.

Surveyor. The Chatham Officers' Report of the 5th May, proves that the defects complained of in the frame of the "Boscawen" principally arose from the improper mode adopted by the Woolwich Officers, as that defect did not exist in the "Cumberland." The models of the "Boscawen's" stern, as altered by the Committee, and the "Cumberland's," are ready for inspection. I consider the Committee's stern to have serious faults, which do not exist in the "Cumberland's," and am prepared to prove them.	I beg to remark, that not having examined the latter ship, I cannot pretend to say from what cause the mode was adopted. The stern proposed by the Committee may have faults which do not exist in the "Cumberland's," but I am of opinion that, on the whole, the Committee's stern, both in effect for fighting the guns, and strength, is very superior to the "Boscawen's," as originally formed, and from its construction will prove to be strong, and a formidable battery.
Surveyor. I am of opinion that the shift of frame adopted in the Service is superior to this recommendation, and I am borne out in that opinion by a Report of Mr. Hawkes, dated November 30th, 1833, wherein he compares the frames of the "Clarence" and "Vanguard," which Report is sent herewith.	I am ready to admit that the shift of frame adopted in the Service may be good in some points, but gives much difficulty in the conversion of the frame, and, in my opinion, not equal to that recommended by the Committee, either for strength, economy, or conversion of the timber, and for the reasons set forth and fully explained by the Committee in their Report. As it regards Mr. Hawkes's Report, of the 30th November, 1833, I consider that this does not bear on the relative merits of the two shifts of timber, as it appears only a comparison between the "Clarence" and "Vanguard," neither of which ships the Committee had any reference to in forming the shift of frame, their object being only to shorten the timbers to the least possible length, so as to maintain a proper degree of strength, and leaving it open as much as possible to the convertors when providing the timber, in order that a great variety of lengths of timber, according to the store, may be brought into use.
Surveyor. These observations do not refer to the mode of filling adopted generally on the 21st January and 10th September, 1833, when a section, after the favourable Report of the greater number of the Dock Yards, was generally promulgated.	With regard to the filling in the openings between the timbers, the plan proposed by the Committee does not differ very materially from the mode adopted generally on the 21st January and 10th September, 1833; the only difference consists in working them only three inches within the timbers, and all of one thickness, or solid, instead of in two, rabbetted, by which means much labour would be saved, as well as materials, and of equal benefit to the ship. Also, that they extend only so high up, that a current of air may pass under the strakes below the orlop clamps, which, in my opinion, is the most preferable situation, inasmuch as it causes a great current of air to pass in the fore, main, and after holds, whereby the ship will be materially benefited, and prevent the great accumulation of dirt, so commonly found in the openings on paying off.
Surveyor. I feel convinced, from full experience, that the mode adopted in November 1832 is far superior to	I am persuaded, from long experience, that the length of scarphs for large beams, namely twelve

any other mode of scarphing beams, both with regard to strength and economy.	feet, is by no means too long, and that letting in the lips flush, as lately introduced, has a great tendency to weaken the beam at that part; and I have known instances of the kind, particularly in French men-of-war.
Surveyor. I cannot recommend their being so close. I consider from sixteen to twenty inches quite sufficient. I would prefer thicker deck plank.	With respect to the distances of the openings between the half beams, namely, not closer than from sixteen to twenty inches, instead of from twelve to sixteen inches, as proposed by the Committee, I am of opinion the former will occasion the treenails and other fastenings to be too great a distance from each other, notwithstanding the deck plank may be increased in thickness.
Surveyor. I consider the forked knees very superior in point of strength.	I consider that plane knees, with ears on both arms, as recommended by the Committee, will prove stronger than the forked knees, and will cause much less labour and difficulty, both in shipwrights' and smiths' works.
Surveyor. I am opposed to this suggestion, as it would add much to the smiths' work without an equivalent; for the fabric, I am convinced, would be stronger if the riders, crutches, hooks, &c., were let into the frame. *Surveyor.* I am strongly opposed to the use of treenails; bolt nails are much superior, and great improvement would be accomplished if they were more general. No good shipwright would fasten the plank as herein alluded to. The scantling may be reduced if treenails are done away with.	I am of opinion the iron riders, with ears, &c., as proposed by the Committee, will be found superior in point of strength to the iron plate riders, and as the bolts in the riders proposed by the Committee will pass through the bottom, by which means both inside and outside planking will be secured; whereas the iron plate riders are let in flush, and secured to the timbers by alternate screw and plain bolts, the plain bolts passing through the bottom plank, and in the event of shrinkage (which it is impossible to prevent) their strength to the fabric will decrease. And further, the iron riders proposed by the Committee will likewise be of great advantage in repairing ships; for instance, supposing there are several timbers near each other rotten, and require shifting, the diagonal plate riders which are under the planking will require to be taken out previous to replacing the said timbers, to do which it would be necessary to take off the planking, clamps, &c., in wake of the said plate riders, although the planking, &c. may not be defective; whereas if iron riders were adopted (as recommended by the Committee), they might be unbolted, and the defective timbers shifted without disturbing so much of the thickstuff and plank, and of course a great saving of expense. And further; if treenail fastenings under water should be resorted to, the plate riders will be an impediment in getting the treenail holes through the inside planking, &c. I am further of opinion that treenail fastening, in certain situations, particularly under the light line of floatation, are quite equal in point of strength to everything which may be required of them, and less expensive than copper or mixed metal bolt nails; from long experience, I can but favourably consider treenail fastening, when not too profusely applied.

Surveyor.

I see no improvement in the scale shown in the Table referred to.

With regard to the scale of dimensions for the several beams, waterways, thickstuff, and planking, recommended by the Committee, I am of opinion it is an improvement, particularly with respect to the increased sizes in their depths or mouldings, more especially on those decks where an increased weight of guns takes place.

Surveyor.

There is such a variety of bows and sterns in the Navy, that I am at a loss to find data on which to form a comparison.

It is necessary to have ports in every direction on bows and sterns, in order that guns may be moved from one to the other as the direction of the object fired at changes; and I can discover no reason for placing ports at a great distance apart, as they will most probably never be worked or fired simultaneously.

I again refer to my remarks on the stern of the "Boscawen," on the 5th April, where my opinion is fully described.

I perfectly agree with the Surveyor that there are such a variety of bows and sterns in the Navy; and being impressed with the same ideas, I have given this most important subject my best consideration, with a view to give the utmost possible strength to each and every part of the ship; particularly in plans offered for the construction of the bows and sterns of Her Majesty's ships-of-war, so as to admit of the guns being placed to give the best, possible means of offence and defence.

I am further of opinion, it is very desirable to get as great a distance between the ports as can be consistently procured, with a view of better working, training, and cross firing the guns.

Surveyor.

In the "Trafalgar," or "Vernon," and other sterns planned by Mr. Lang, the protrusion of the false work embarrasses, and in many instances renders the port useless.

The timbering of the stern is so massive and heavy, the openings for light and ventilation so few, that an extraordinary immersion abaft is the consequence, which must have a bad influence on the properties of the ship; and it cannot be imagined that such a weight of useless timber at the extreme, and on the superstructure, can be beneficial in any respect.

As regards the false work to the sterns, I am of opinion it is very objectionable, and that it embarrasses the firing of the guns.

The additional weight of timber I consider but small, so that it is not likely to affect the sailing qualities or ease of the ship, and not more than is necessary for maintaining a proper shift to each other. I should consider it would not bring her by the stern more than an inch.

Surveyor.

In all new ships this has been the practice, and the channels are in consequence narrower; but in the old ships their breadth of beam would not admit of it, as it would infringe too much on the angle of the rigging, and the consequent support of the masts.

As it regards the breadth of the channels and form of the topside, as proposed by the Committee, so as to keep the muzzles of the guns outside of the shrouds when trained, it is true this evil has been remedied in ships built after the Surveyor's plan; and being convinced of the great advantage likely to accrue thereby, I am induced to recommend its general adoption in all new ships.

I have, &c.

(*Signed*) J. ATKINS.

From Mr. ATKINS, *Sheerness Dock Yard.*

SIR, *13th February*, 1843.

Adverting to that part of the Admiralty Letter of the 21st ultimo, and your Minute of the 22nd, transmitting a copy of a letter from Mr. Lang, the Master Shipwright of Woolwich Yard, explaining his reasons for differing with the other Master Shipwrights who were on the Committee upon two essential points, and directing me to report whether Mr. Lang's arguments and explanations on the said two points in any degree alter my former opinion, and if not, to state my reasons in detail for adhering thereto; I beg most respectfully to state, with reference to the statement of Mr. Lang, that the "Committee having come to resolutions on the diagonal truss frame and safety keels, which his judgment and experience strongly condemn, and that the Committee having never had a fair opportunity of fitting a ship on the proper principle, or proving its merits by actual examination," this appears to me to be an extraordinary assertion, when, at the same time, Mr. Lang must be aware that the members of the Committee have built and repaired many ships and steam vessels; and I should conclude that they were fitted on the proper principles, the ships being built by Drawings sent to the Dock Yards for the Officers' guidance; and I have no doubt but the Committee are as competent to judge of the merits, &c. as Mr. Lang, some of them having had as many years' experience as himself.

I would also report, that I am still of opinion the iron riders, as proposed by the Committee, would be found superior in point of strength to the iron plate riders; and I see no reason why the planking cannot be wrought to adhere to the frame, and as the bolts in the riders proposed by the Committee will pass through the bottom, by which means both inside and outside planking will be secured; whereas the iron plate riders are let in flush and secured to the timbers by alternate screw and plain bolts—the plain bolts passing through the bottom plank; and in the event of shrinkage (which it is impossible to prevent) their strength to the fabric will decrease. And further, the iron riders proposed by the Committee would likewise be of great advantage in repairing ships. For instance, supposing there are several timbers near each other rotten, and require shifting, the diagonal plate riders which are under the planking will require to be taken out previous to replacing the same timbers; to do which it would be necessary to take off the planking, clamps, &c. in wake of the said plate riders, although the planking, &c. may not be defective; whereas, if the iron riders were adopted (as recommended by the Committee), they might be unbolted, and the defective timbers shifted without disturbing so much of the thickstuff and plank, and, of course, a great saving of expense.

With regard to that part of Mr. Lang's letter, wherein he states—"as these riders so placed by the Committee terminate at the underside of the lower deck, and the very heavy weight of guns above on the side of the ship commencing from this place, there will be the hinge for working of the ship." As the shelf-piece to the lower deck, together with the clamps, waterways, knees to the beams, securing the ship fore and aft, I consider it the strongest part of the ship, and therefore cannot conceive it possible to become an hinge; besides, before any deflection can take place on the frame where the plates are placed, there must be a degree of opening and separation on the inside and outside planking; consequently the riders proposed by the Committee being much stouter, will give the greatest support, and should the wood shrink from the iron riders, we have the means of firring them up.

In respect to the safety keels and thick strakes, it is well known that they are extremely expensive in the first cost, from the large timber that is required to make them, together with the additional labour, when from any accident they are required to be shifted, it is attended with great difficulty and expense; and in the event of a war, when it so frequently occurs that ships get their keels injured, it would occasion a great delay in making these good, from their complicated construction.

As it regards breaking the sheer of the "Trafalgar" very much less than other first rates, being attributable to the safety keels and plate riders, I am of opinion that the cause was not wholly owing to the introduction of the plate riders and safety keels, but to the combination of the planking, shelf-pieces, thick waterways, iron knees, &c. &c.

I remain, &c.
J. ATKINS.

From Mr. OLIVER LANG, *Woolwich Dock Yard.*

Surveyor.

I beg to refer to my remarks on this subject, dated the 5th of April last. I consider that the doing away with the quarter port, on the point of impunity, is a great sacrifice.

In answer to the Surveyor's remarks, I do affirm that the new stern of the "Boscawen" has not one point undefended, and produces a more perfect battery than any ship in the Navy, of her class; and

The Chatham Officers' Report of the 5th of May, proves the defects complained of in the frame of the "Boscawen" principally arose from the improper mode adopted by the Woolwich Officers, as that defect did not exist in the "Cumberland." The models of the "Boscawen's" stern, as altered by the Committee, and the "Cumberland's" are ready for inspection. I consider the Committee's stern to have some serious faults, which do not exist in the "Cumberland's," and am prepared to prove them.

with regard to the assertion of the Surveyor, that the defects complained of in the stern of the "Boscawen," arose from the improper mode adopted by the Woolwich Officers, and that these defects did not exist in the "Cumberland," I have to repeat, that these defects *did exist*, and in a greater degree, in the "Cumberland," before the stern was altered the *second time*, than in the "Boscawen," and that the stern and frame of the latter was laid *off correctly* from the Drawing; which was proved to be the case to the Committee, who carefully examined the Drawings and the ship. The Surveyor's assertion, that he is prepared to prove some serious faults in the Committee's stern, which do not exist in the "Cumberland's," is not a proof that he can do so.

Surveyor.

I am of opinion that the shift of frame adopted in the Service is superior to this recommendation, and I am borne out in that opinion by a Report of Mr. Hawkes, dated the 30th November, 1833, wherein he compares the frame of the "Clarence" and "Vanguard," which Report is sent herewith (see A).

In my answer to Mr. Hawkes's Report, dated Pembroke Yard, May 1836, I have fully proved the fallacy of this statement, and also that Mr. Hawkes now contradicts his Report, having joined the Committee in the condemnation of this mode of framing.

In reference to the Report of Mr. Hawkes to the Surveyor (see page 10), in which he attempts to prove that the "Vanguard" was built at a very much less amount per ton than the "Clarence," and other ships of her class, I have, in the first place, to state, that from the great breadth of the "Vanguard," in proportion to the "Clarence," &c., she ought to be built at much less per ton, as the breadth increases the nominal tonnage in a very great degree, without any real increase of capacity. The "Vanguard" is 2,608 tons old measurement, whilst the "Clarence" is only 2,279; the "Vanguard" has to carry 80 guns only, and a proportionate quantity of stores; the "Clarence" carries 84 guns, and can stow a greater quantity of water, stores, &c., than the "Vanguard."

It is a known fact, that the expense of building all ships of similar rates, is in proportion to the launching weight of the ship; and as the weight of the "Vanguard" when launched was more than that of the "Clarence," she must, consequently, have cost more in building.

To show the inconsistency of Mr. Hawkes's statement, it is only necessary to make a few extracts from the Report itself. It will be seen, by referring to the Table in the first page, marked A. that he makes the "Hercules," a ship of only 1,726 tons, cost £65,411; whilst the "Clarence," a ship of 2,279 tons, built on precisely similar principles, is made to cost only £64,384; making the "Hercules," a ship of 553 tons less than the "Clarence," cost £1,027 more.

Mr. Hawkes states that the "Vanguard" cost, building and fitting for ordinary, £47,787. *The*

"*Vanguard*" *never was fitted for a state of ordinary*, but was built to be commissioned. The expense incurred on her at Pembroke was between £56,000 and £57,000; and about £4,000 or £5,000 more was expended on her before she sailed from Portsmouth. I beg to remark also, that when the "Vanguard" was built, 22½ per cent. had been taken off from the price schemes, by which the "Clarence" was valued, and which Mr. Hawkes ought to have known when he sent forward this Report to favour the Surveyor.

In stating that 578 loads 43 feet of converted timber was used in the frame of the "Clarence;" 571 loads 16 feet in the "Vanguard;" and 533 loads 43 feet in the "Collingwood;" he attempts to account for the great difference between the "Collingwood" and "Vanguard," by stating that a much greater quantity of Italian oak timber was used in the former than the latter ship, forgetting, if this were correct, the same reason would explain the small difference between the "Vanguard" and "Clarence." The quantity of Italian oak timber stated by him to be used in each ship, is as follows viz.

	Loads.	Feet.
Collingwood	179	13
Vanguard	43	30
Clarence, only . .	2	31

This certainly "needs no comment;" it is a perfect specimen of the value to be attached to the statements of Mr. Hawkes, who, in the conclusion of his Report states, the disposition of the frame introduced by the Surveyor is preferable to that in universal practice. This is in direct contradiction to the opinion of the whole Committee of Master Shipwrights, of which Mr. Hawkes was a member, who unanimously joined in condemning the Surveyor's shift of frame, as being very much weaker and inferior in every respect to the method usually adopted.

Surveyor.

These observations do not refer to the mode of fillings adopted generally on the 20th January and 10th September, 1833, when a section, after the favourable report of the greater number of the Dock Yards, was generally promulgated (see Papers herewith, B)..

I see no reason to alter my opinion on this subject given on the 18th October, 1832.

Surveyor.

I feel convinced, from full experience, that the mode adopted in November 1832 is far superior to any other mode of scarphing beams, both with regard to strength and economy (see Report C.).*

The mode of scarphing beams prepared by the Committee is far superior to that recommended by the Surveyor; and at the same time I think I may be allowed to consider the opinion of five practical

---

* *Portsmouth Yard*, 18*th July*, 1842.

Sir,

With reference to your Memorandum of the 16th instant, to report the state of the beams of the several decks of the "Pique," we beg to state that we have examined the beams in the different decks, and have not perceived any signs of straining or weakness whatever.

The "Pique" being almost a new ship, sufficient time has not elapsed to prove the efficiency or otherwise of the beams.

I cannot recommend their being so close: I consider from sixteen to twenty inches quite sufficient. I would prefer thicker deck plank.

Master Shipwrights much more conclusive than the Surveyor's, who can have had no "experience" in these matters, as to the best mode of scarphing beams, the necessary distance apart, and also with regard to the best form of a knee for securing the beam to the ship's side.

Surveyor.

I consider the forked knees very superior in point of strength.

Forked knees cause *much* more labour, are more expensive, *liable to split the ends of the beams,* and a very improper application for security, as they cannot be brought to act in a position to hold the beam to the ship's side.

Surveyor.

I am opposed to this suggestion, as it would add much to the smiths' work without an equivalent, for the fabric, I am convinced, would be stronger if the riders, crutches, hooks, &c., were let into the timbers.

The riders should be let into the timbers one half their thickness, which method was first introduced into Her Majesty's Service by me upwards of twenty-three years since, and found to be very beneficial for strengthening the fabric; but this is different to the plans the Surveyor has sent to the several Dock Yards for building his ships, which have hitherto corresponded with the four other Master Shipwrights' opinion on the Committee; but in his present Report he contradicts his former orders, and now advocates the "riders being let into the timbers," as practised by me in building the "Trafalgar," 120-guns, "Comet," "Lightning," "Meteor," "Black Eagle," "Medea" steam vessels, and many others, instead of on the *planking* of the ship, as recommended by them.

Surveyor.

I am strongly opposed to the use of treenails; bolt nails are much superior, and great improvement would be accomplished if they were general. No good shipwright would fasten the plank as herein alluded to.

The scantling may be reduced if the treenails are done away with.

The Surveyor, by his statement that "bolt nails are much superior to treenails," proves that he has no knowledge of the proper mode of fastening a ship for "no good shipwright," nor even an indifferent one, would advocate the driving of short bolts. All bolts should be driven through and clenched. A treenail, well caulked at the ends, is a very superior fastening to a short bolt: and it is an erroneous assertion, that the doing away treenails would admit of the scantling being reduced. Bolt fastenings not

---

In this ship none of the beams are scarphed in the original manner, and therefore we cannot compare the two plans under like circumstances; but our opinion is, that they will stand equally well with the old plan beams, provided they are wholly made of English or African oak.

R. BLAKE,
J. STURDIE,
J. WATTS.

Admiral Superintendent.

The following is the amount of weight, and the expense reduced, on the beams of a ship of each class over those of the old plan.

Guns.	Tons.	£	*s.*	*d.*
110	48	1,108	12	0
80	28	663	15	0
36	14	312	10	0
26	8	189	15	0

The common method of scarphing beams was unanimously decided by the Committee of Master Shipwrights to be stronger than that introduced by the Surveyor; and as the scarphs *need not* be longer in the old method than in the Surveyor's, and can be put together more substantially with the same quantity of materials, an increase of expense, instead of saving, must be incurred by putting the beams together on the Surveyor's plan, as the workmanship will be more in one of his beams than in those on the old plan, the former having hooked scarphs, and the latter plain.

O. LANG.

	only increase the expense considerably, but greatly add to the weight of the ship, and is in some degree the cause of the Surveyor's vessels swimming so deep.
Surveyor. I see no improvement in the scale shown in the Table referred to.	This method of fitting shelf-pieces for securing the beams, was first introduced into Her Majesty's Service by me upwards of thirty years since, and I fitted them in the "Vernon," the Surveyor's ship, when building at this Yard, in the year 1832, who has adopted the principle since, but for want of professional knowledge, has mistaken the effect, and altered the form by placing the depth for the breadth: this misapplication considerably reduces the strength, and, of course, accounts for his "seeing no improvement in the scale."
Surveyor. There is such a variety of bows and sterns in the Navy, that I am at a loss to find data on which to found a comparison. It is necessary to have ports in every direction on bows and sterns, in order that guns may be moved from one to the other, as the direction of the object fired at changes; and I can discover no reason for placing ports at a great distance apart, as they will most probably never be worked or fired simultaneously.	My experience during the last war, when numberless ships came under my observation, after having been engaged in battle, enabled me to discover the necessity for having a proper distance between the ports, by no means less than nine feet asunder from centre to centre, but as much more as could be conveniently obtained, to allow of the guns being fought without coming in contact with each other; and the ports should be so arranged, that every gun might be fired direct, without having recourse to an immoderate angle of training. The ports in the "Trafalgar's" stern and quarters are so placed, which renders the guns as effective in all points as any of those on her broadside.
Surveyor. I again refer to my remarks on the stern of the "Boscawen," on the 5th April, where my opinion is fully described.	Answered by the Committee on the 9th April, in which opinion I coincide.
Surveyor In the "Trafalgar," "Vernon," and other sterns, planned by Mr. Lang, the protrusion of the false work embarrasses, and, in many instances, renders the ports useless. The timbering of the stern is so massive and heavy, the openings for light and ventilation so few, that an extraordinary immersion abaft is the consequence, which must have a bad influence on the properties of the ship; and it cannot be imagined that such a weight of useless timber at the extreme, and on the superstructure, can be beneficial in any respect.	With regard to the Surveyor's statement of the weight of the "Boscawen's" stern, the Members of the Committee proved it to be *incorrect* by actual measurement; he states the weight to be as *eleven to seven* on his plan, while it was found to be only *forty-four pounds* difference from that of the Committee's: the stern, on his plan, was weak and inefficient, although there were bands of iron of eighteen hundred weight placed round it for support, and having four feet four inches overhanging or rake more than her present stern, which must naturally have increased the balance abaft; and being so injudiciously framed as to require solid fillings between the timbers to get fastenings for the planking (such as may be seen in the "Blazer" steam vessel, now refitting at this port), the true weight of the Surveyor's sterns, notwithstanding their weakness, will be found to be very considerably more than those sterns constructed by the Committee, or on my principle, which have no protrusion of false

work to embarrass a single port, or render it useless, the false work having been so fitted as to be removed with facility, when required for fighting; there is both light and air, as much as can be consistent with a battery in a man-of-war; and "no good shipwright" would say there is one useless or unnecessary piece of timber in the whole fabric.

With regard to immersion, the Surveyor would wish to make it appear that the "Trafalgar" exceeds other three-deck ships, and has taken an unfair selection for that purpose, being all old square stern ships, and omitting his "Queen," with her inefficient round stern, and also the "Britannia," "Nelson," "St. Vincent," "Queen Charlotte," "Ville de Paris," &c., square stern ships on the old plan, all of which draw more water, both afore and *abaft*, than the "Trafalgar," her mean draught of water being considerably less than any ship of her class; and she has proved herself in launching to be the strongest man-of-war yet built, by the scientific arrangement of a smaller quantity of materials in her construction, which will enable her to carry a larger proportion of stores with comfort and safety, without an increase of immersion; she has an additional quantity of beams abaft, filling up the open space of the old bread room below on the orlop, and the flat of the deck continued quite aft, with proper substantial fastenings for the security of the stern post, of which the Surveyor appears to have had no knowledge, by his attributing the trim of the ship wholly to the construction of the stern: this of course adds a little to the weight, but has effectually remedied the general weakness complained of in that part of Her Majesty's ships during the last war, when they were encountering the heavy gales of wind and seas off Brest, blockading the French fleet. The launching draft of water is no criterion to judge from: it is the form of the body and not the weight of the stern that gives this effect. The "Trafalgar" being a little finer in the run, must consequently set by the stern on her light lines, as all our best sailing ships have done; but when she becomes deeper in the water her increased displacement abaft will bring her to about twelve or fourteen inches of an even keel, which will be found to be her sailing trim; when I trust she will prove herself to be a perfect man-of-war on all points, sailing, strength, stowage, fighting her guns, &c. And I also beg to observe, that the weight taken by the Committee, only bears reference to the *right aft* part of the stern; but from the Surveyor's excessive length of counter, and additional rake of the stern, as adopted by him in the "Queen," above that of the "Trafalgar," the whole of the timbers, plank, fastenings, &c., composing that useless, inefficient, and overhanging superstructure, is all in addition to the weight of the stern on my plan; which needs no further refutation on my part as to the weight of my stern compared with his.

The unjust observations made by the Surveyor on the sterns of the late Sir Robert Seppings, I feel it my duty to notice, having been the Assistant Surveyor at the time the alteration took place.

The "Prince Regent," 120-guns, and "Owen Glendower" frigate, were two of the first of Sir Robert's construction with round sterns; and the "Owen Glendower" was not altered in consequence of *weakness* or a *bad shift* of timber in her frame, but to form a different disposition of the ports at the request of the late Captain, the Honourable Robert Spencer, who commanded her *once*, and not "seven or eight times" as represented.

The alterations in the stern of the "Prince Regent" was not her frame timbers, or any thing relative to the strength of the fabric, but merely the external fancy ornamental part, once, and not "five or six times;" and on my late survey of the ordinary, I had occasion to visit these ships, and did not perceive any change had taken place.

Surveyor.

In all new ships this has been the practice, and the channels are, in consequence, narrower; but in the old ships, their breadth of beam would not admit of it, as it would infringe too much on the angle of the rigging, and the consequent support of the masts.

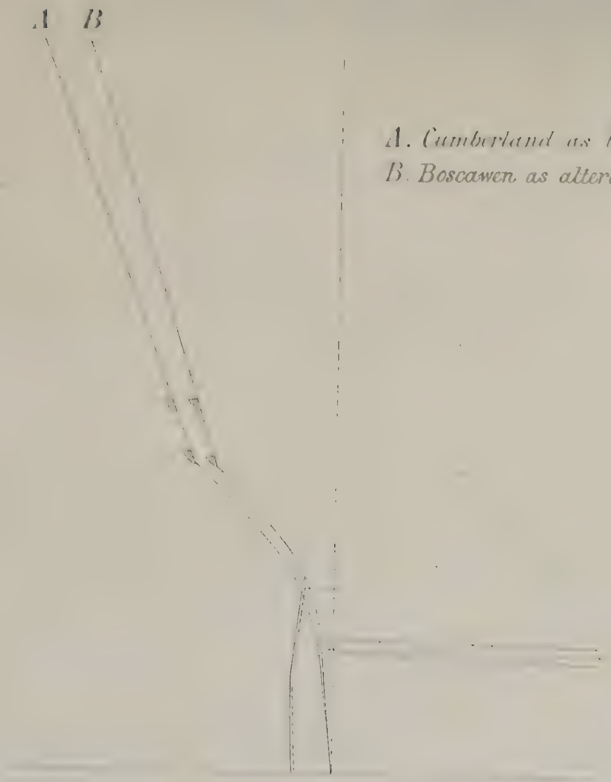
If the Surveyor means his own by "all new ships," he has mistaken the subject; the breadth of the channels was never proportioned to the breadth of the ship, but according to the *form* of her top-side, to admit of the shrouds clearing the hammock stantions; this was always the practice in the old ships; and it does not appear that the "breadth" of these new ships alluded to by the Surveyor, has prevented some of them from rolling their masts overboard, which, I believe, rarely, if ever, occurred to the old ones.

(*Signed*) O. LANG.

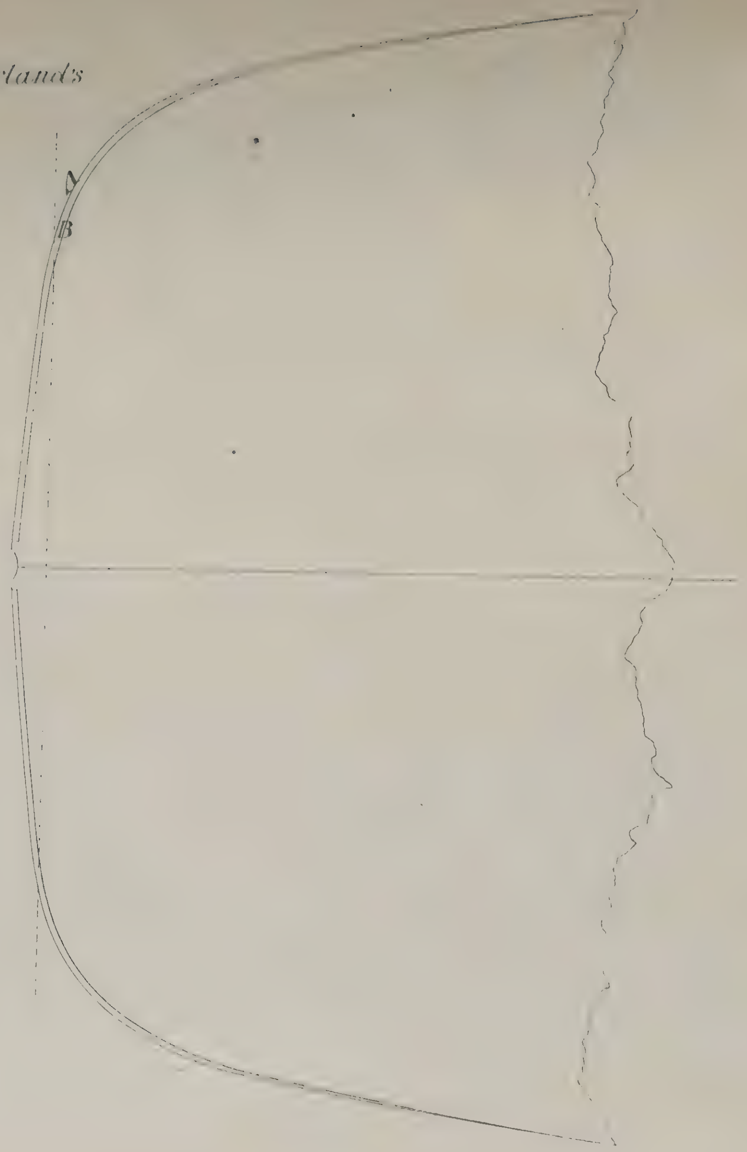
LONDON:
Printed by W. Clowes and Sons, 14, Charing Cross,
For Her Majesty's Stationery Office.

A.

Comparative Rakes and Form at Gun Deck lower Sill of Cumberland's Stem as built, and Boscawen's Stem as altered by Committee.



A. Cumberland as built.
B. Boscawen as altered by Committee.



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Standidge & C° [illegible]

Fig. 1.

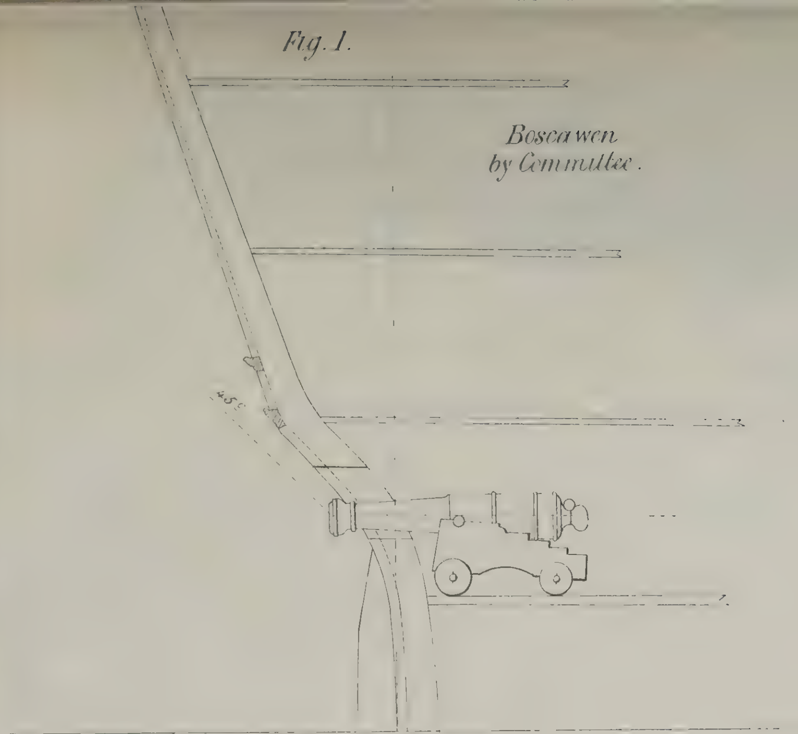
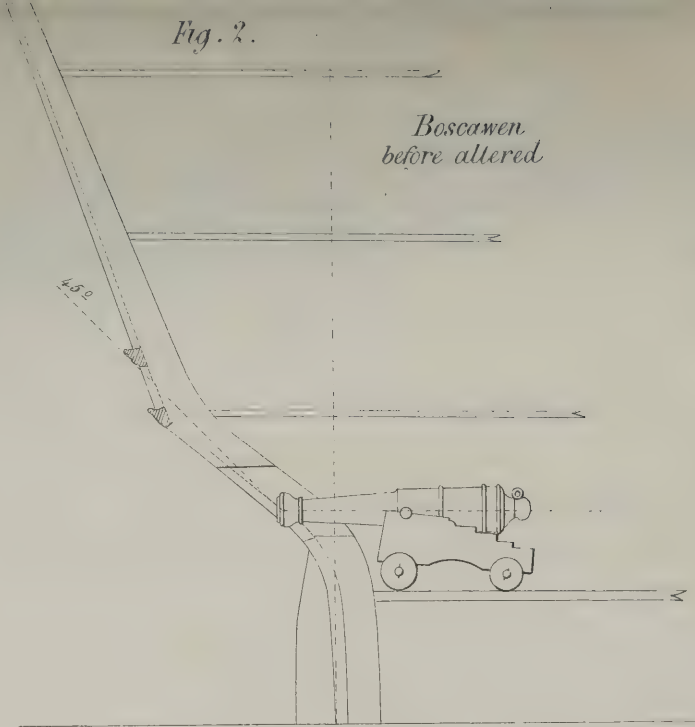


Fig. 2.



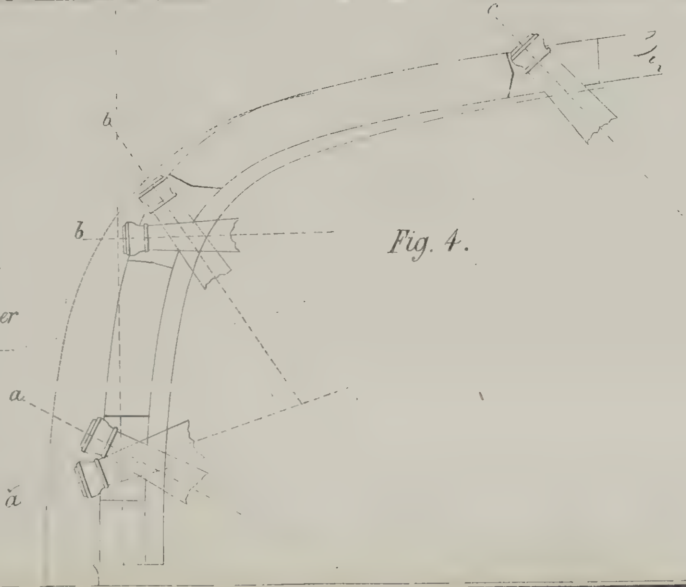


Fig. 4.

a´. Gun will cross with
the opposite one.
a & b. will cross each other
b & c. ... do .... do ....

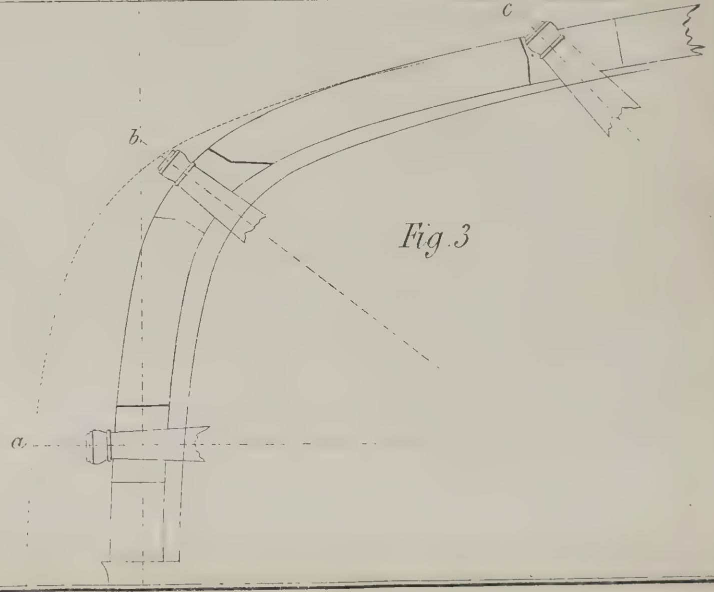


Fig. 3

b. Gun, cannot be
trained & the
explosion is 6^{ms}
within the upper
sill.
a. Gun, the
explosion within
the counter as
shown above.

41
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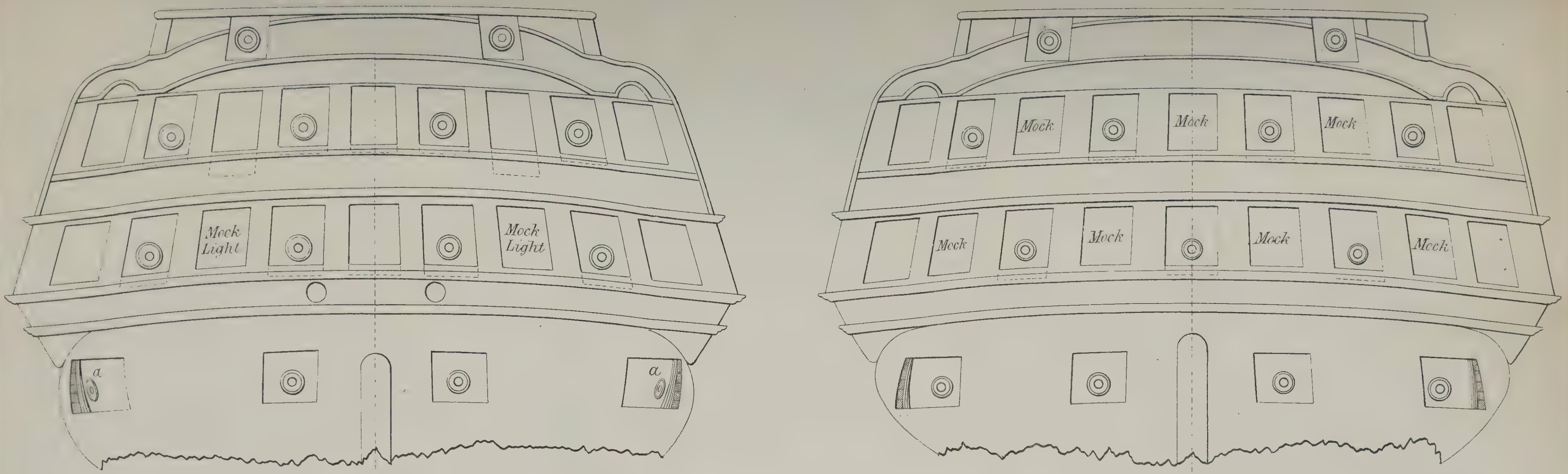
Fig. 5.



The Guns marked (a) will not fire in a line with the Keel.

Fig. 6.

11

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Wardroom Lights in "Boscawen's" Stern
as altered by Committee.

Fig. 7.

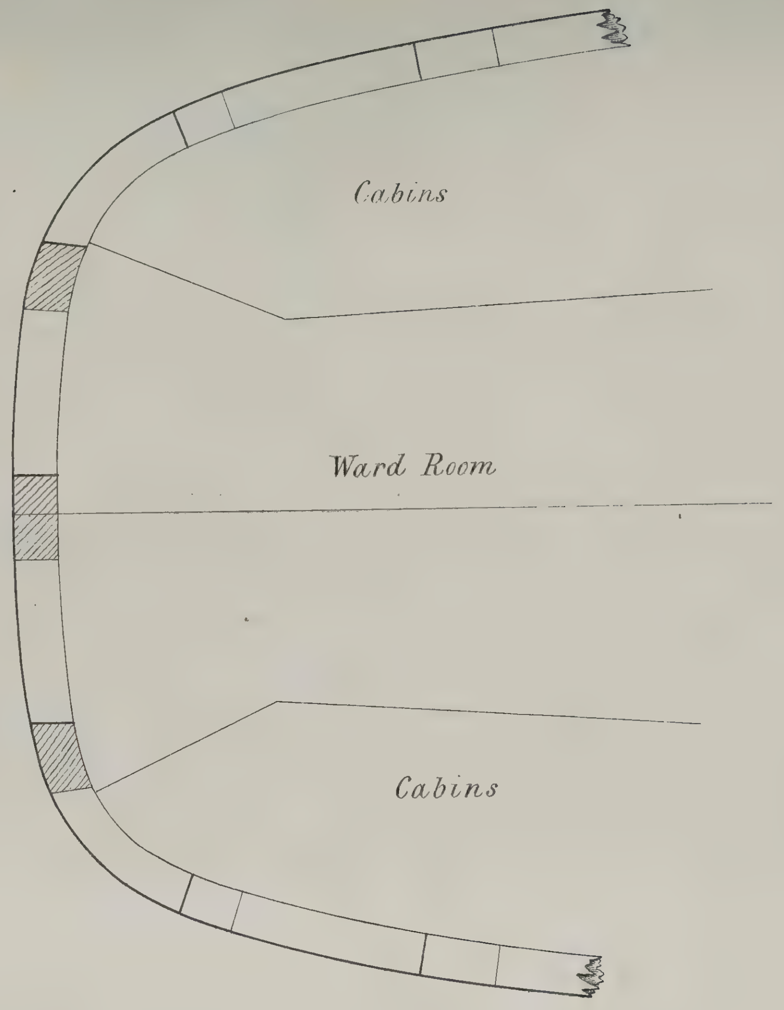

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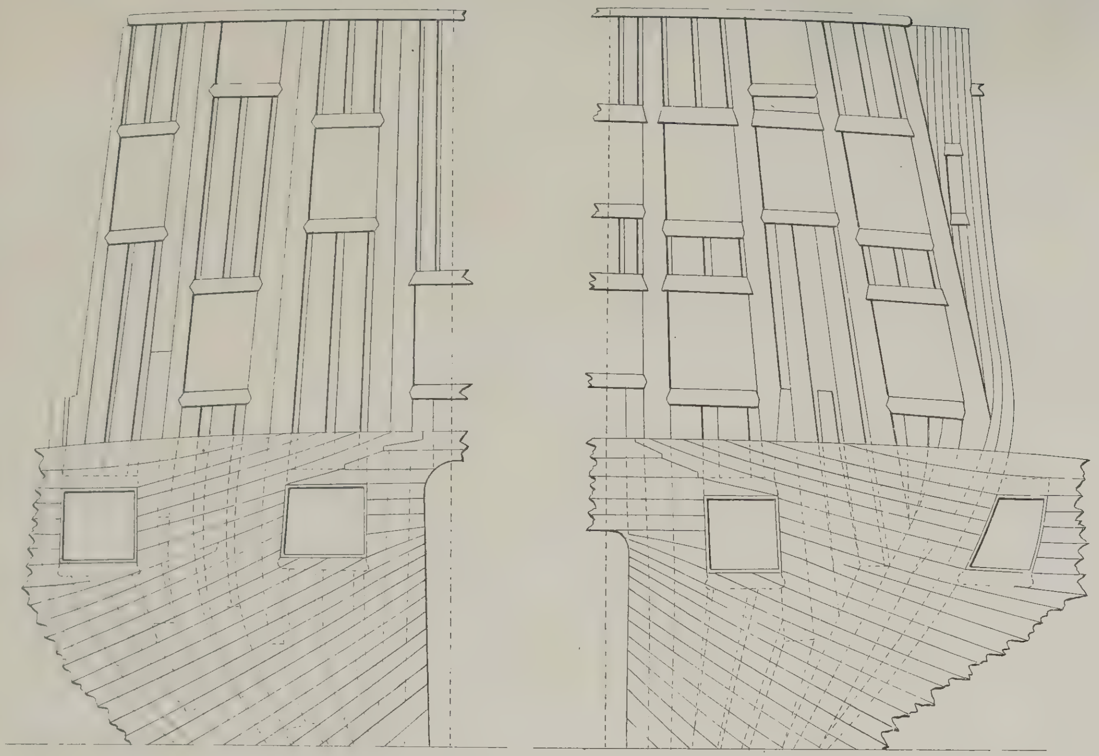
Fig. 8.

Showing the shift of Timber and Plank.

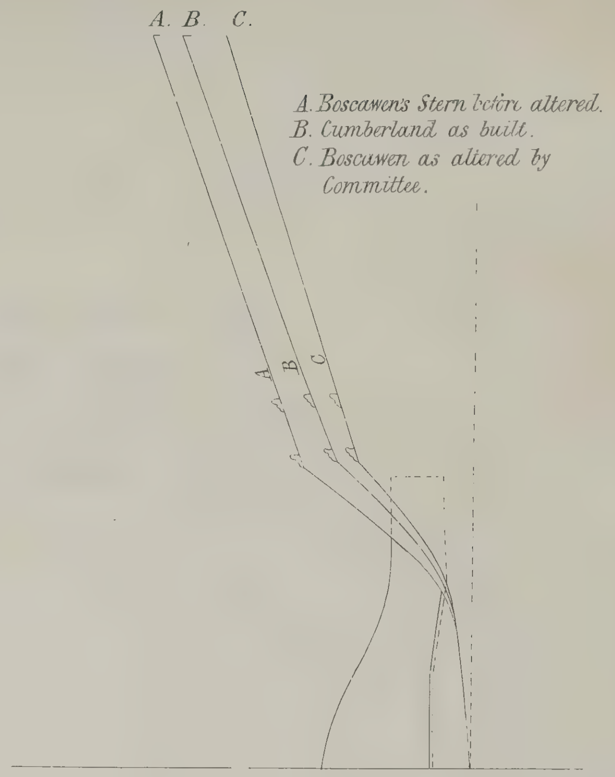


Boscawen by Committee

Boscawen and Cumberland before altered.

Fig. 9.

Showing the comparative protection of the Rudders.



A. Boscawen's Stern before altered.
B. Cumberland as built.
C. Boscawen as altered by Committee.

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Fig. 12.

Gun 12ft. 6in. long. shown in Boscawen's stern before altered

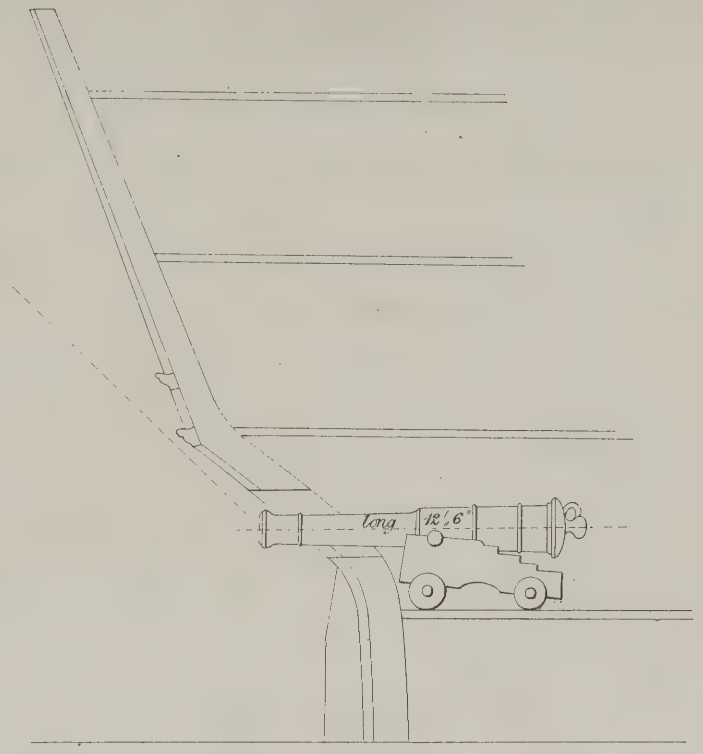

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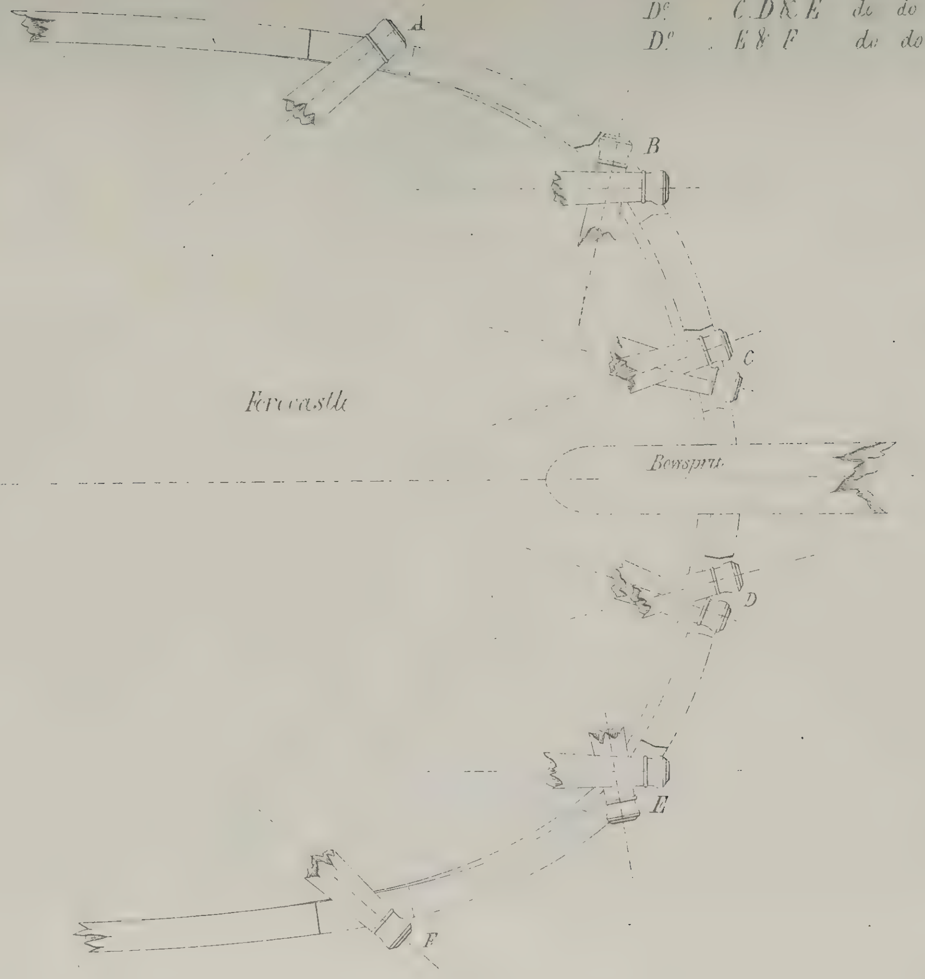
Fig. 13.

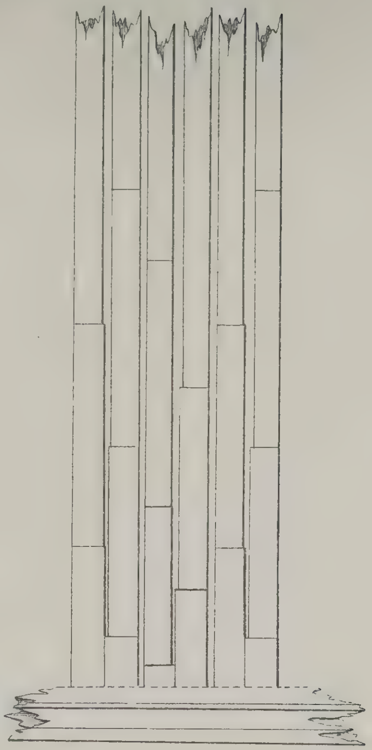


Guns at A. B will cross fire
D^{o} . B. C & D will cross fire.
D^{o} . C. D & E do do do.
D^{o} . E & F do do do

[illegible] & C^{o} Lith. London

Assemblage of three Timbers between
every alternate head and heel.

Fig. 14.



Scale ⅛ of an Inch to a Foot.

18

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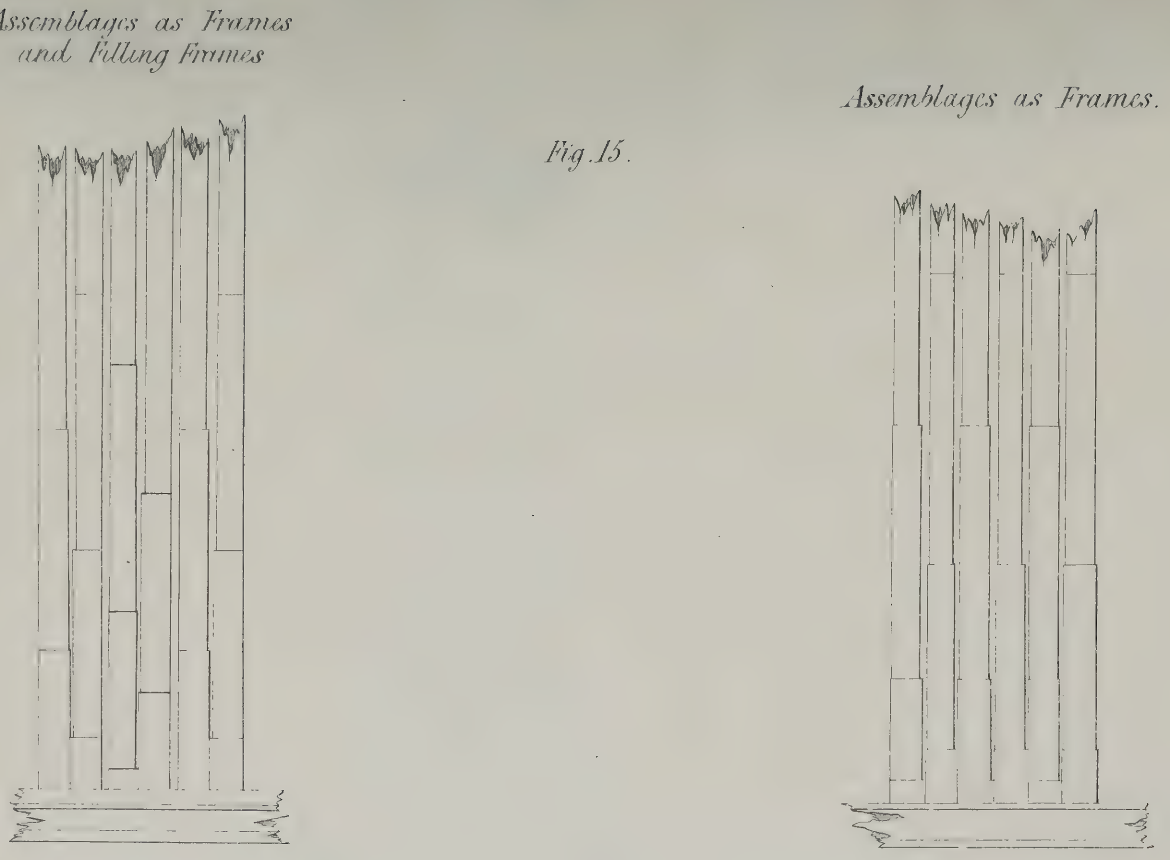


Assemblages as Frames
and Filling Frames

Assemblages as Frames.

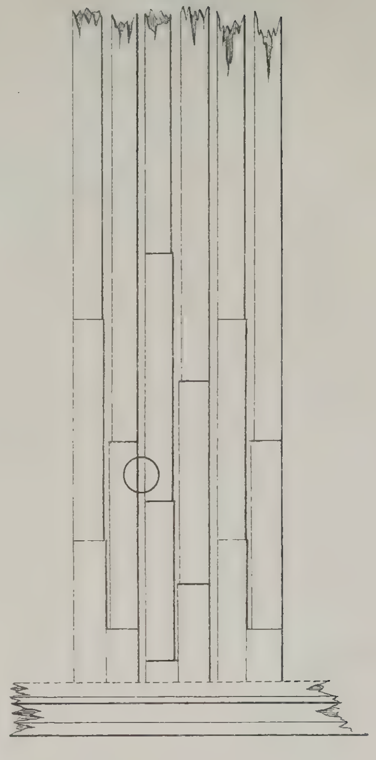
Fig. 15.

Scale 1/8 of an Inch to a Foot

20
Standidge & Cº Litho. London.

Assemblage shewing the
Short Shift as circle.

Fig. 16.



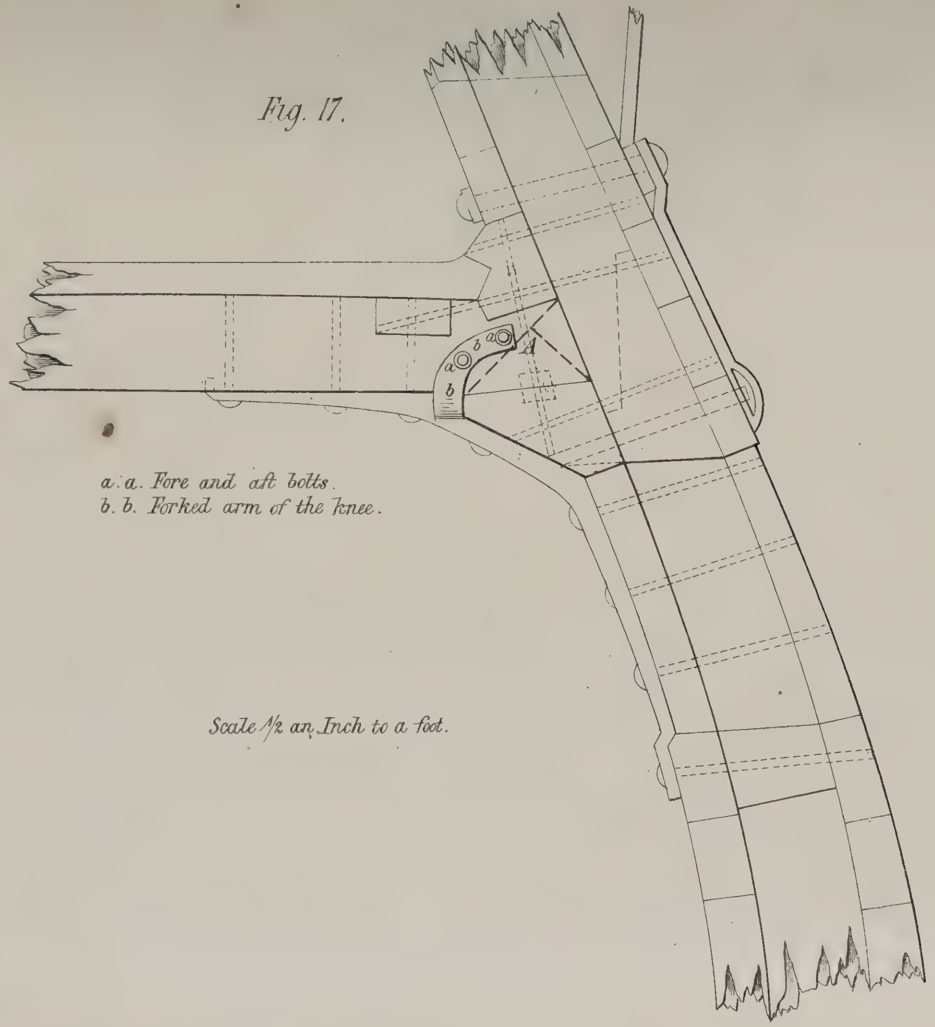
Scale ⅛ of an Inch to a Foot

13
Standidge & Co. Litho. London

Sketch of Beam Ends with forked Knees.

Thick dotted lines A shew the Centres of Motion on each alternate Roll.

Fig. 17.



a. a. Fore and aft bolts.
b. b. Forked arm of the knee.

Scale ½ an Inch to a foot.

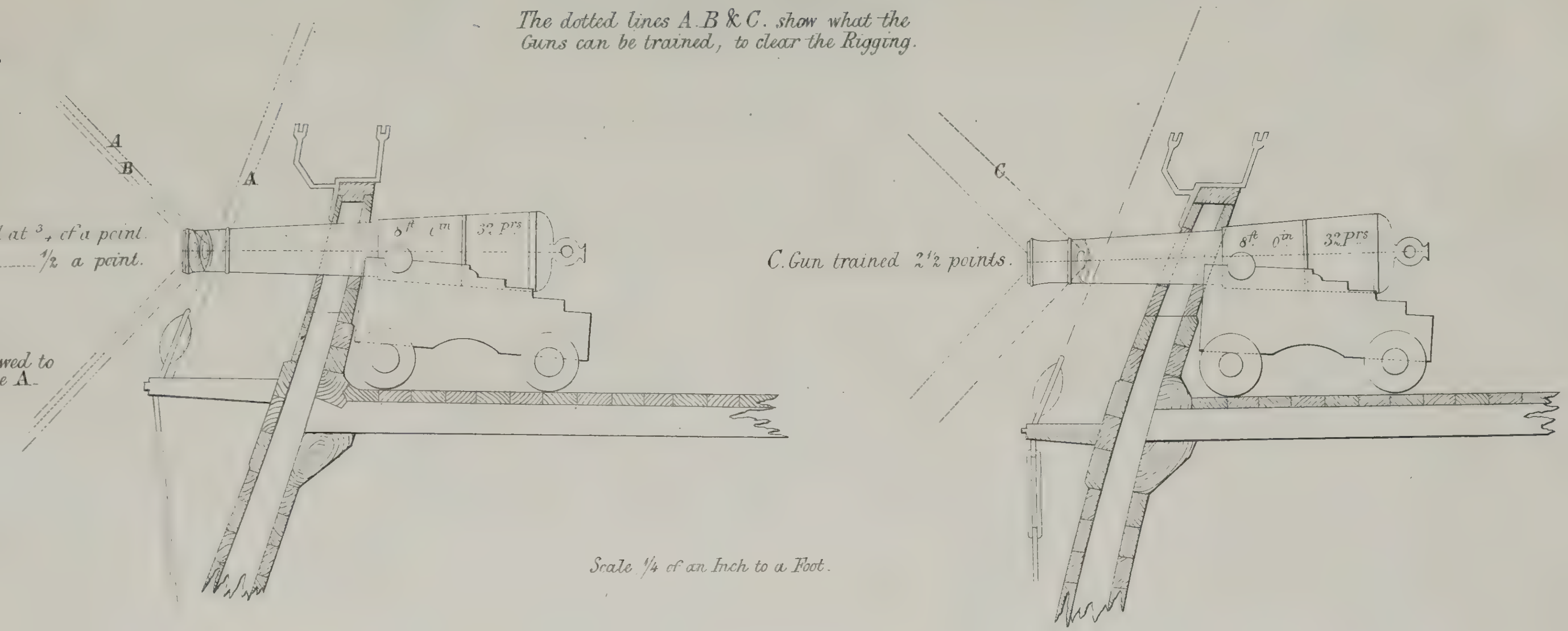
21
Standidge & Co. Litho London

Fig. 18.

Sketch as "Mars".

Sketch, similar to that proposed by the Committee.

The dotted lines A. B & C. show what the Guns can be trained, to clear the Rigging.



A. Gun trained at ¾ of a point.
B. Do .... Do .... ½ a point.

Channel may be narrowed to conform to dotted line A.

C. Gun trained 2½ points.

Scale ¼ of an Inch to a Foot.

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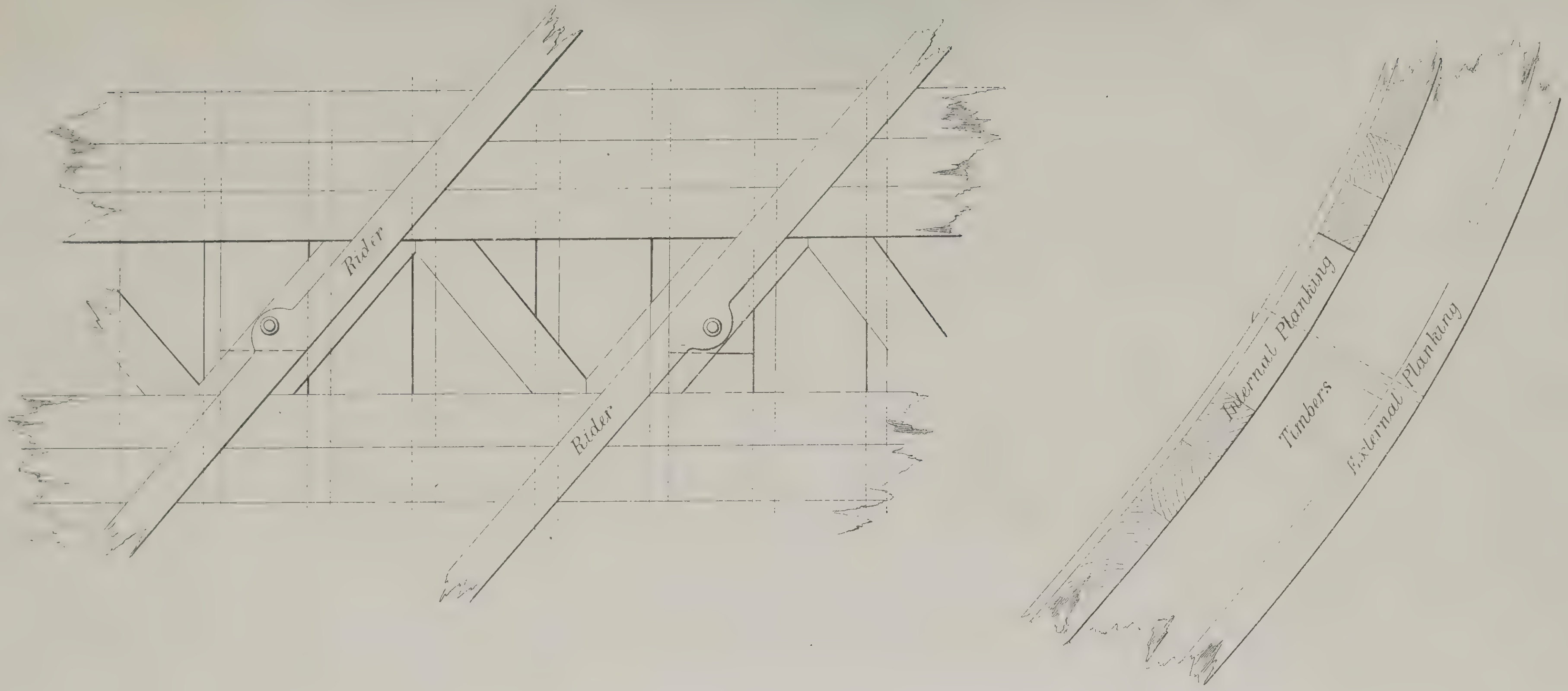
Fig. 19.

Rough Sketch shewing the Combination of Riders on the Thickstrakes and Trusses.



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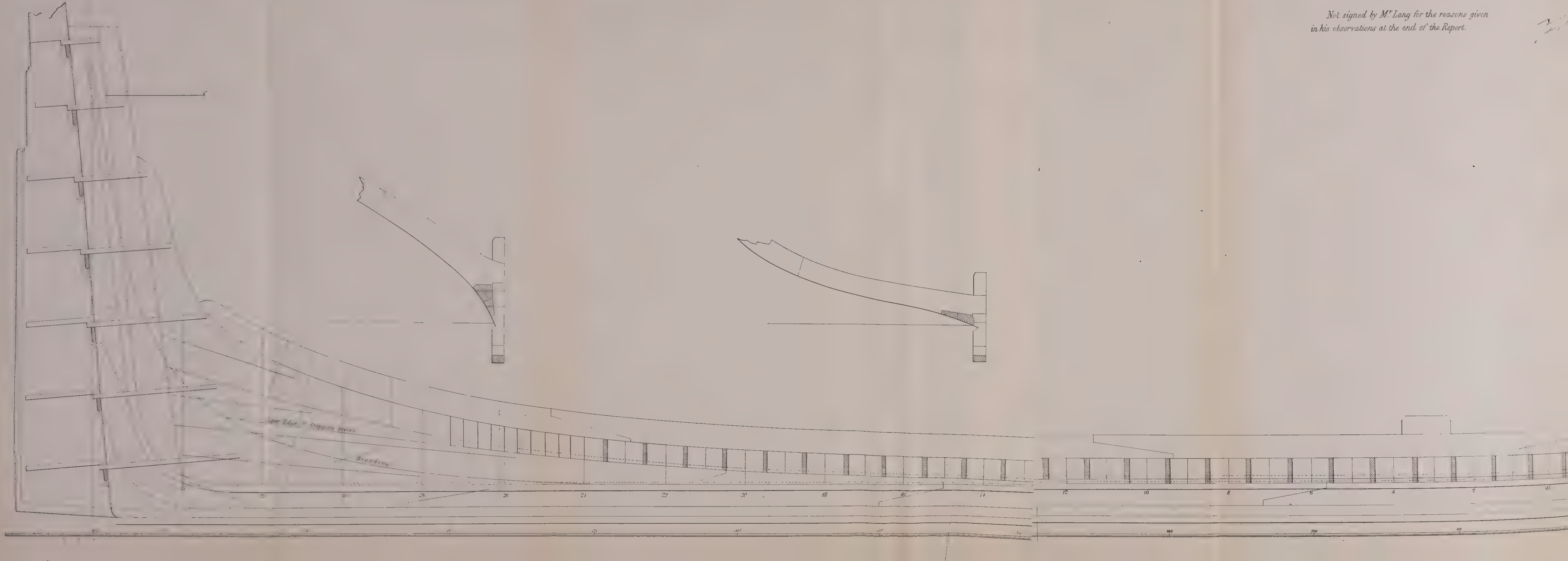
Woolwich Yard,
13th April 1842

A DRAWING *Shewing the D*

which will be equally secure as th

Not signed by Mr Lang for the reasons given in his observations at the end of the Report.



No. 1.

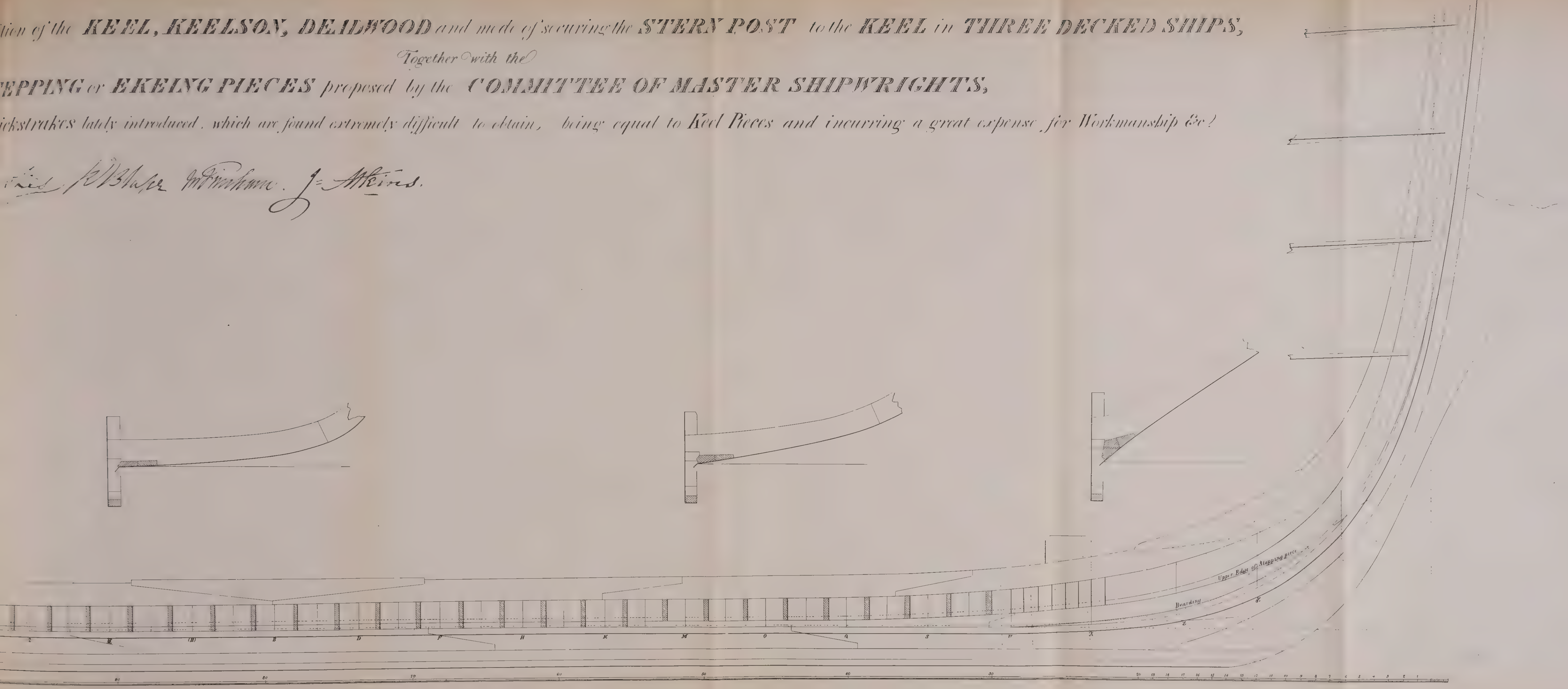
tion of the KEEL, KEELSON, DEADWOOD and mode of securing the STERN POST to the KEEL in THREE DECKED SHIPS,

Together with the

EPPING or EKEING PIECES proposed by the COMMITTEE OF MASTER SHIPWRIGHTS,

ickstrakes lately introduced, which are found extremely difficult to obtain, being equal to Keel Pieces and incurring a great expense for Workmanship &c.

R.W. Blake Wm. [illegible] J. Atkins.



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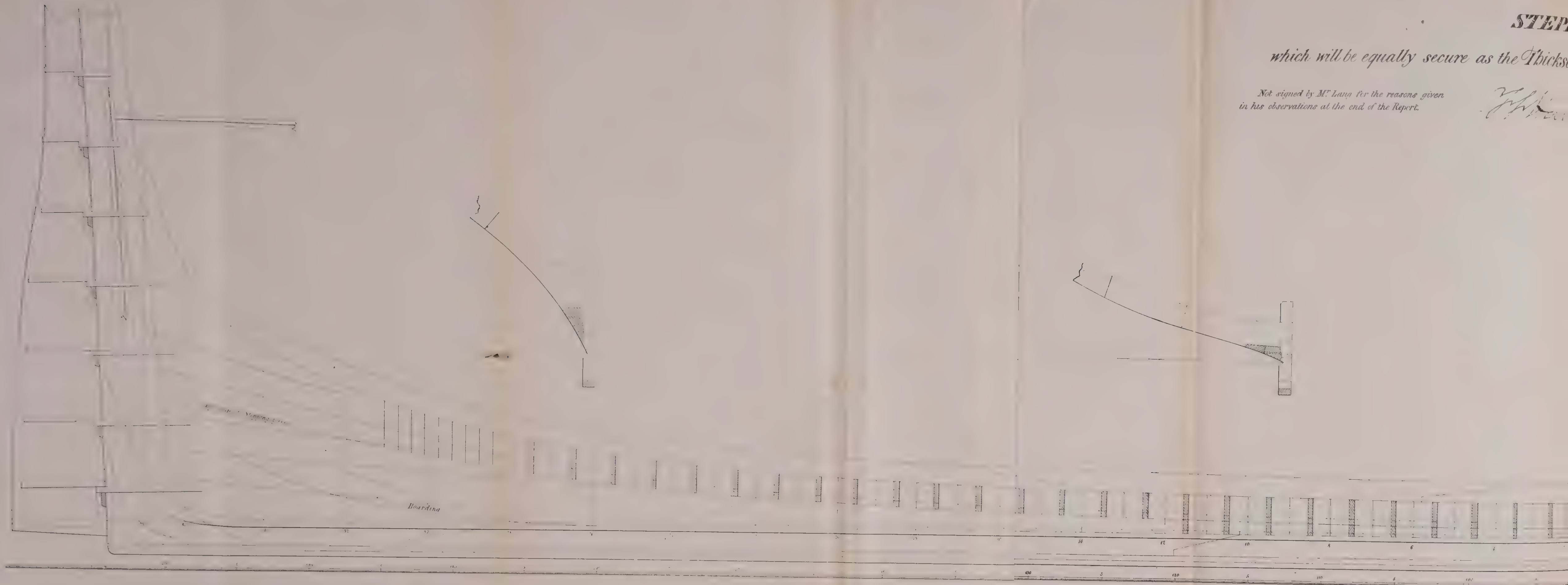
Woolwich Yard,
13th April 1842

A DRAWING Shewing the Dispositi

STEP

which will be equally secure as the Thicks

Not signed by Mr. Lang for the reasons given in his observations at the end of the Report.



the **KEEL, KEELSON, DEADWOOD** and mode of securing the **STERN POST** to the **KEEL** in **TWO DECKED SHIPS,**

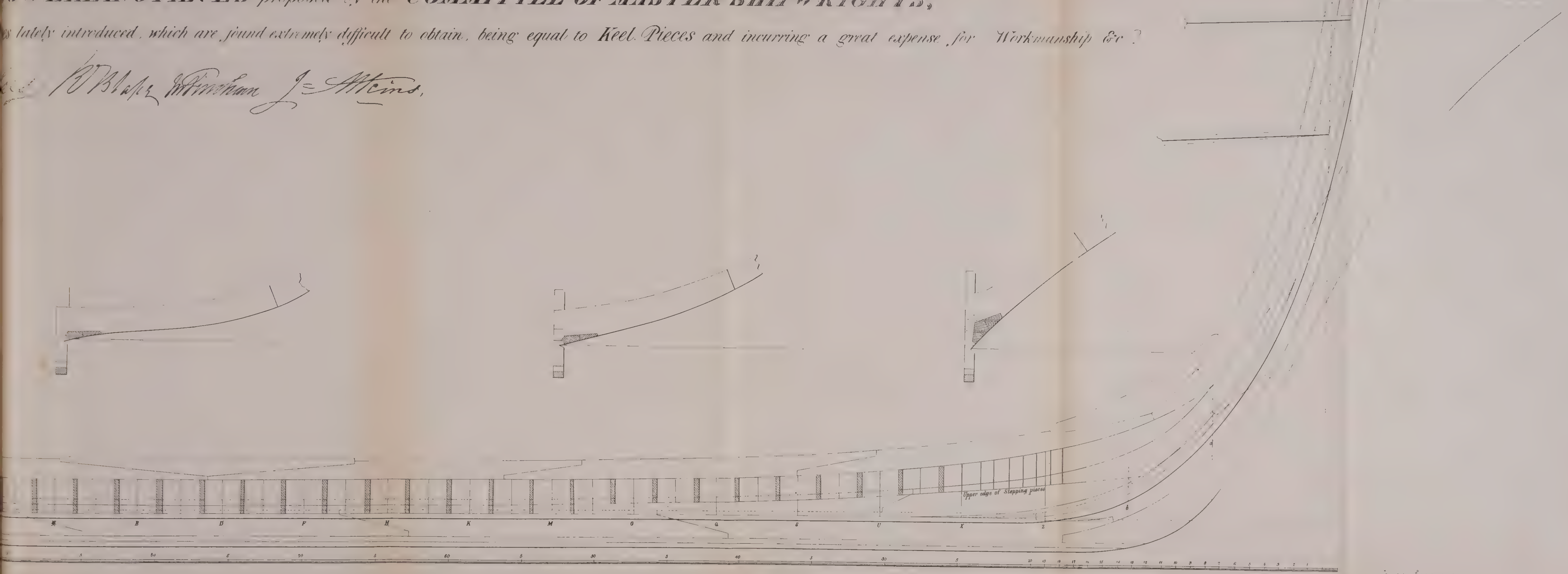
Together with the

G or **EKEING PIECES** proposed by the **COMMITTEE OF MASTER SHIPWRIGHTS,**

s lately introduced, which are found extremely difficult to obtain, being equal to Keel Pieces and incurring a great expense for Workmanship &c ?

No. 2

R Blake Jn Fincham J. Atkins



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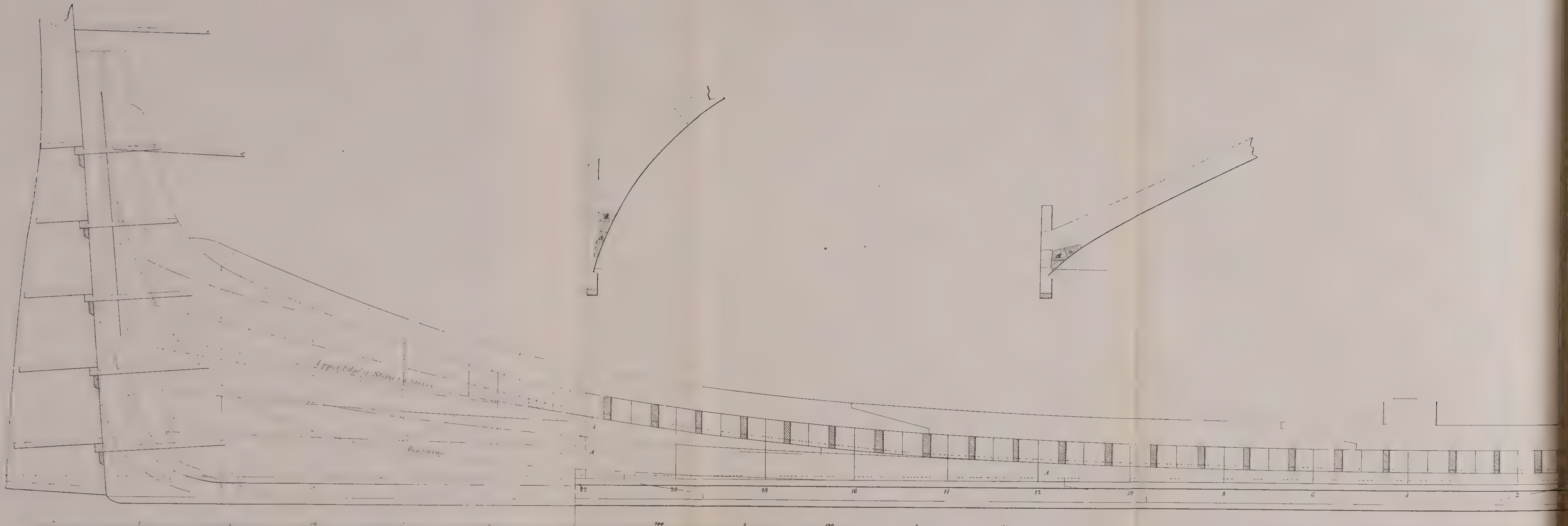
Woolwich Yard
13th April, 1842.

A DRAWING *Showing the Disposition of the* **KEEL,**

STEPPING *or* **EKEIN**

which will be equally secure as the Thickstrakes lately introduced,

Not signed by Mr. Lang for the reasons given in his observations at the end of the Report.



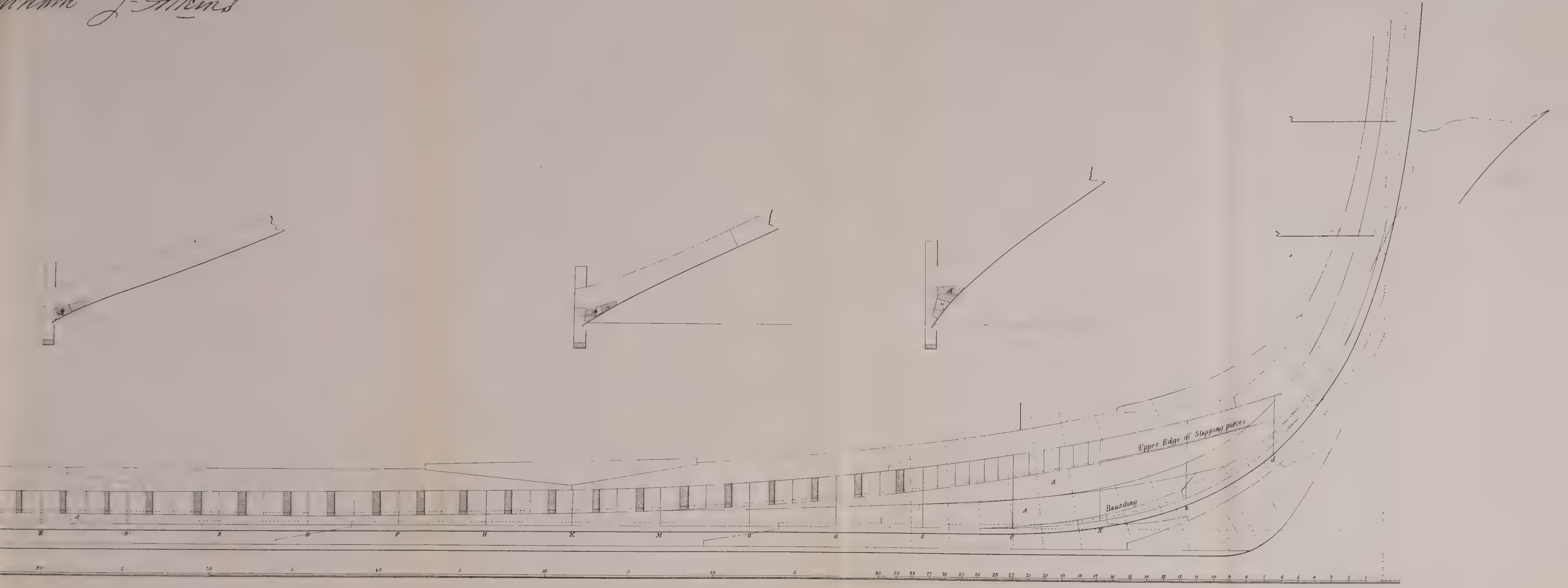
SON, DEADWOOD and mode of securing the STERN POST to the KEEL in LARGE FRIGATES, No. 3.

Together with the

ES proposed by the COMMITTEE OF MASTER SHIPWRIGHTS,

e found extremely difficult to obtain, being equal to *Keel Pieces* and incurring a great expense for Workmanship &c.

inham J. Atkins



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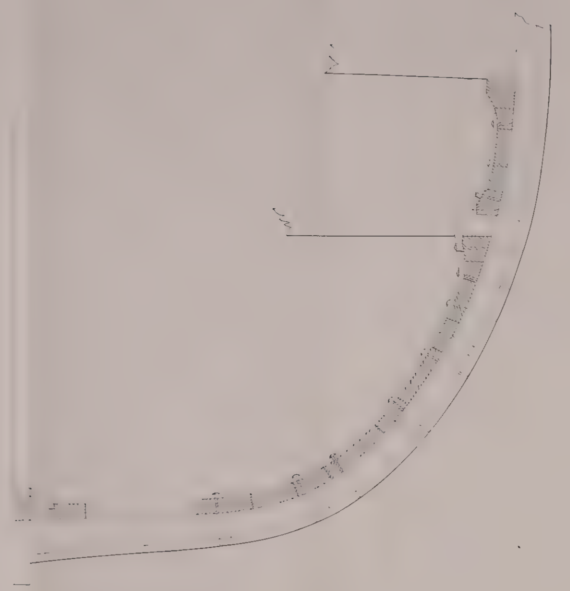

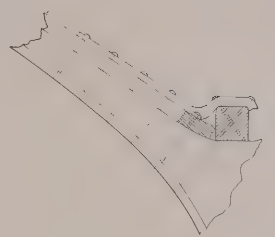

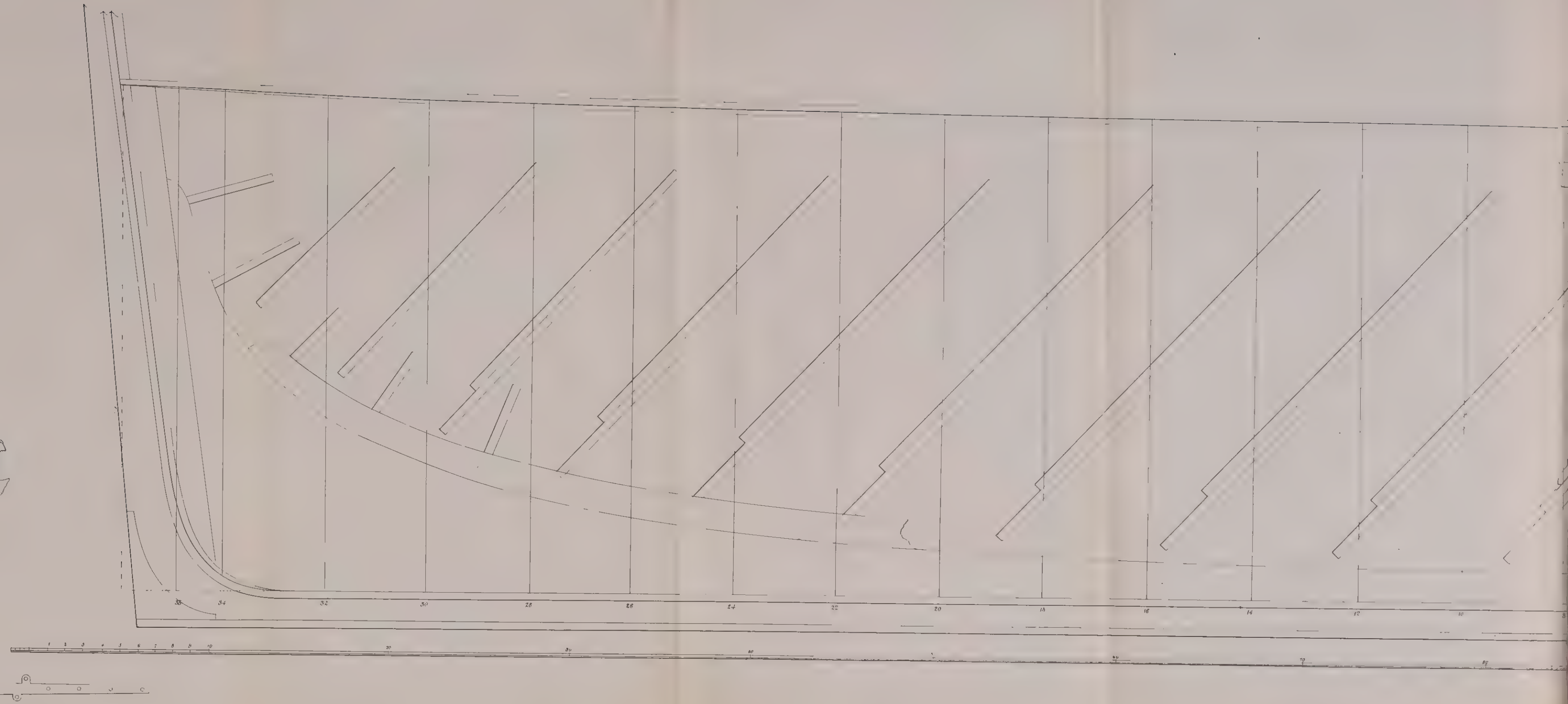
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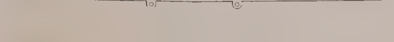


Woolwich Yard.
15th April 1812

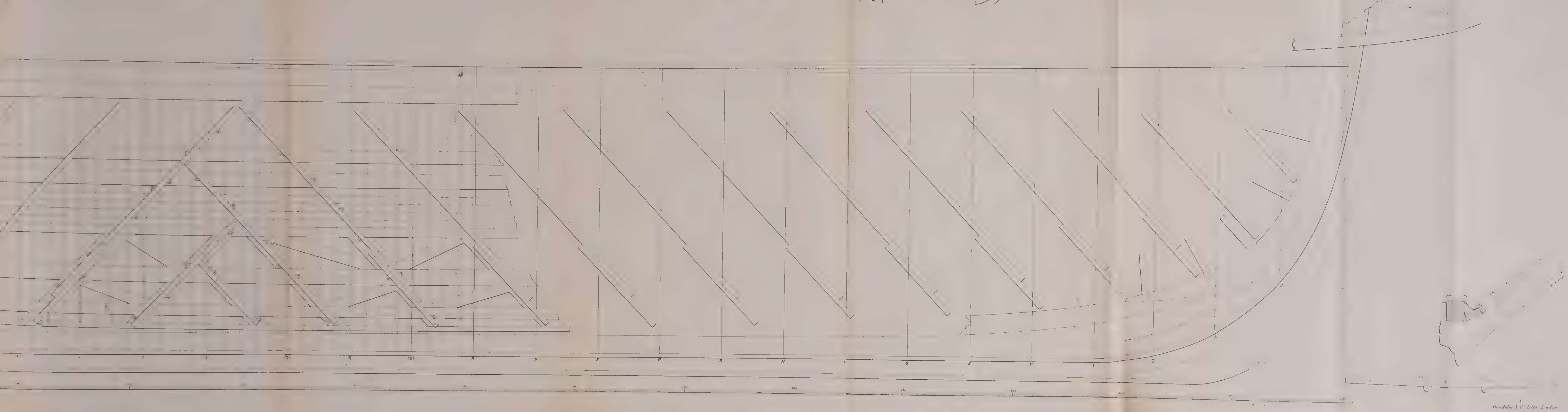
A SKETCH *Showing the mode proposed by the* COMMITTEE OF MASTER SHIPWRIGHTS,

For Thickstrakes at the heads and heels of Timbers, Truſsing, Iron Riders, Hooks and Crutches in Three Decked Ships.

No. 4.

Not assented to by Mr Laing for the reasons given in his Observations at the end of the Report

Jos. Tucker R Blake J Fincham Jn. Atkins.



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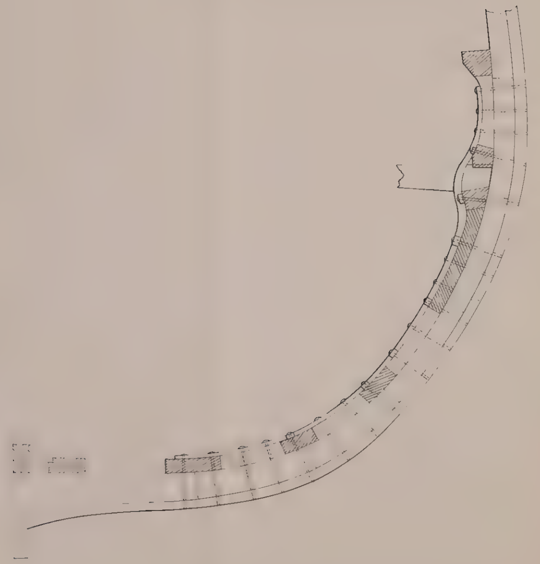

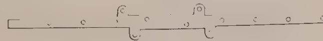

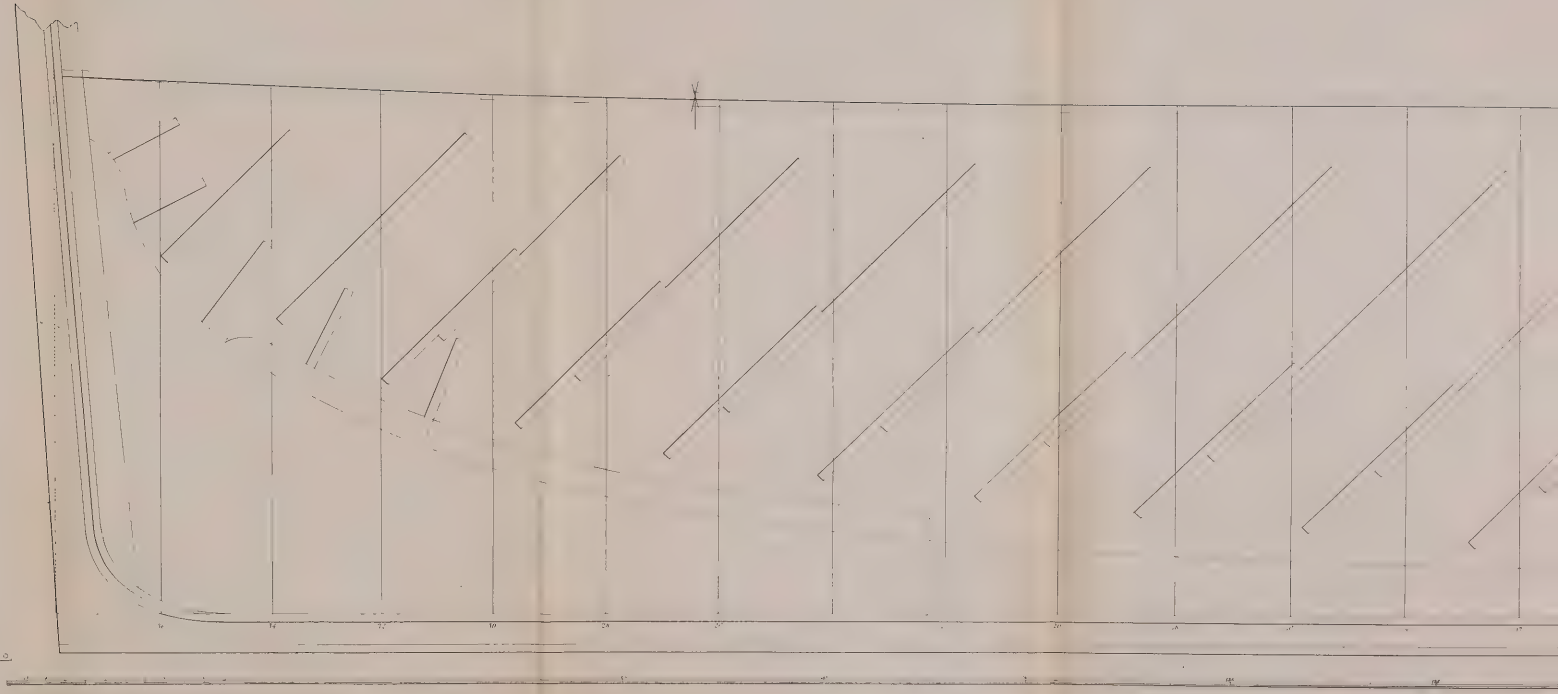
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Woolwich Yard
13th April 1842

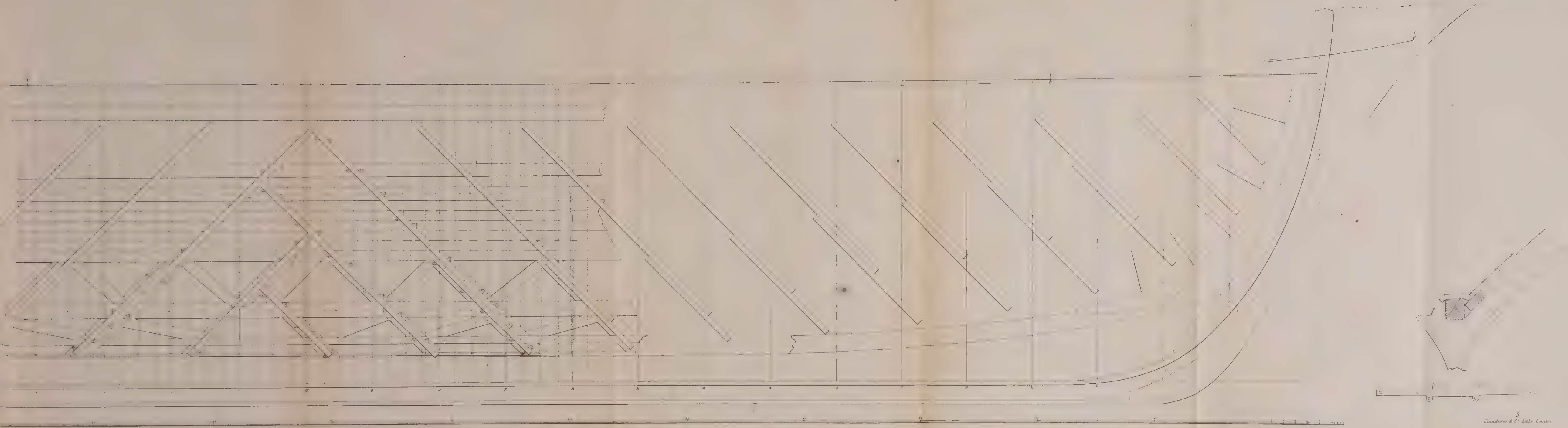
A SKETCH Shewing the mode proposed by the COMMITTEE OF MASTER SHIPWRIGHTS.

No. 5.

For Thickstrakes at the heads & heels of Timbers, Truſsing, Iron Riders, Hooks and Crutches, in Two Decked Ships.

Not signed by Mr Lang for the reasons given in his observations at the end of the Report.

R Blake W Fincham Jn Atkins.



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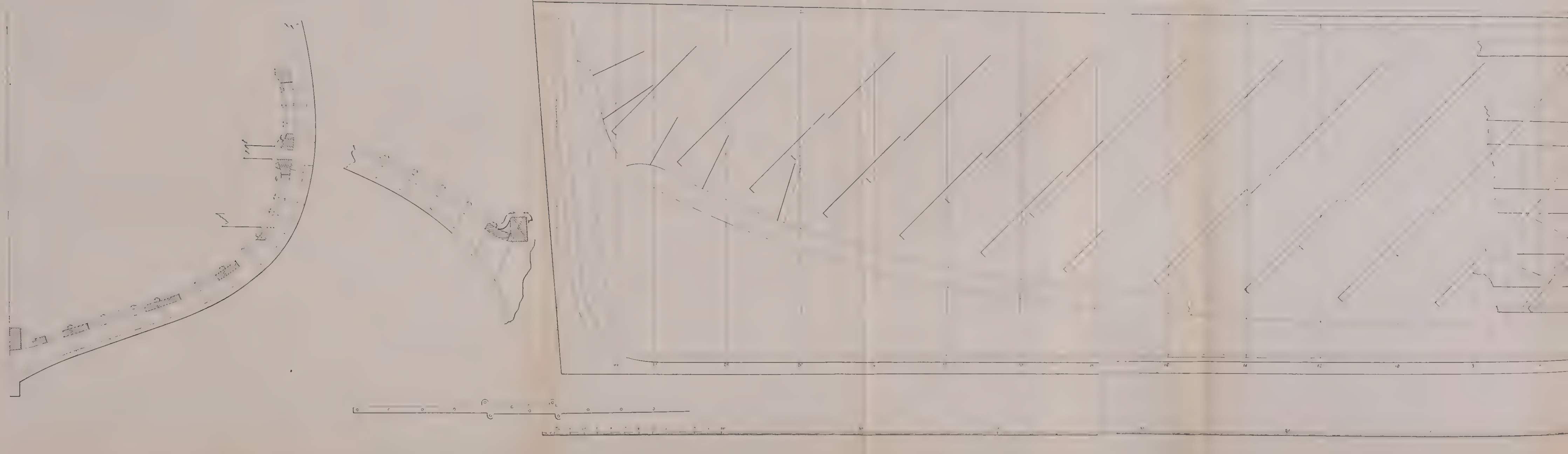
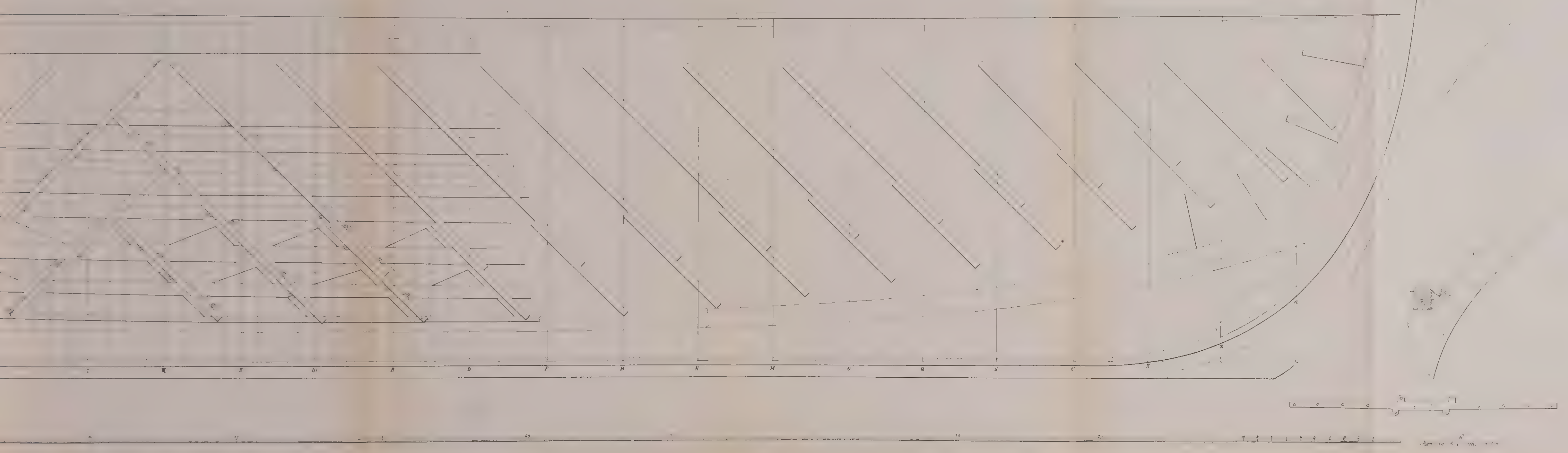


Woolwich Yard. 13th April 1842 | **A SKETCH** *Shewing the mode proposed by the* **COMMITTEE OF MASTER SHIPWRIGHTS,** *For Thickstrakes at the heads and heels of Timbers, Trussing, Iron Riders, Hooks and Crutches in Large Frigates*

No. 6.

R Blake J Fincham J. Atkins



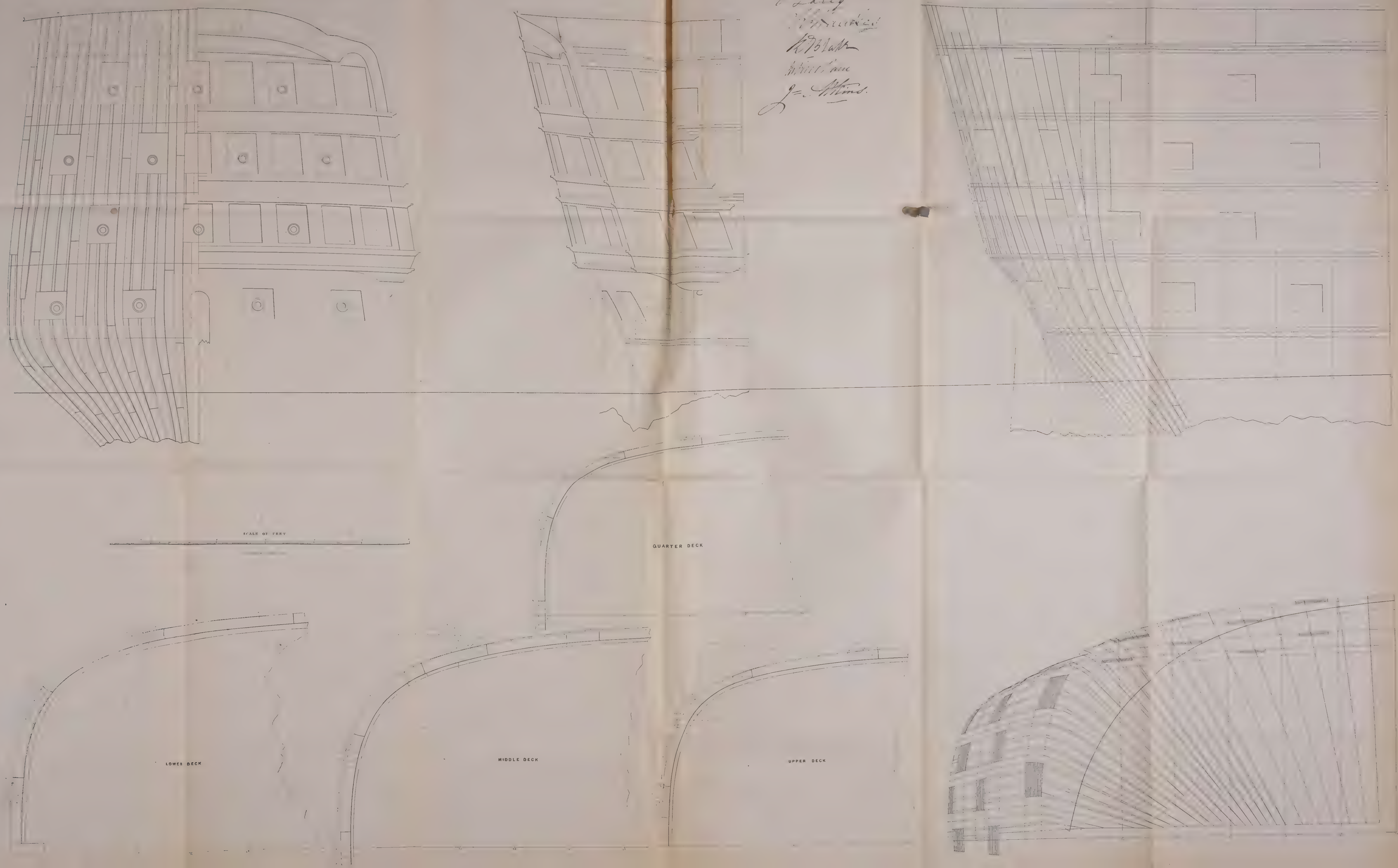
Woolwich Yard
25th April 1842

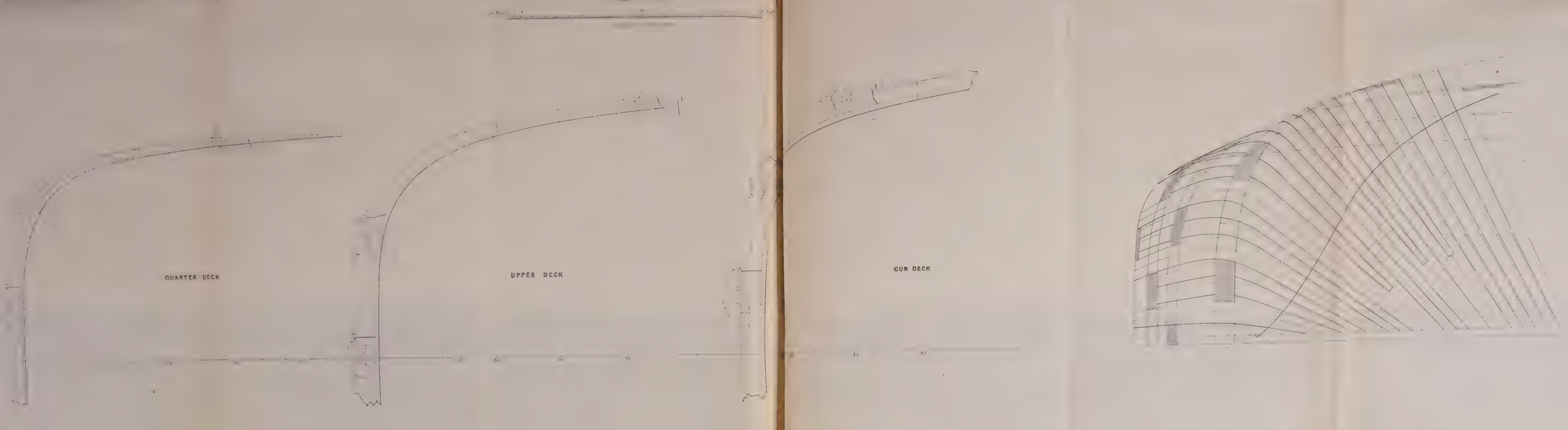
A PLAN OF STERN FOR SHIPS OF THREE DEC proposed by the COMMITTEE OF MASTER SHIPWRIGHTS.

In pursuance of Ad order of 23rd December 1841

It will be seen by the Plans that 14 Guns can be pointed in a line with the Keel, and 9 d, four more on the Poop the whole of these Guns have a proper space between them for their being efficiently worked and will cross fire with each the after Broadside Guns by which every point can be fully defended

O. Lang
[illegible]
R. Blake
[illegible]
Jn. Atkins.




SCALE OF FEET.
10
QUARTER DECK
UPPER DECK
GUN DECK

Woolwich Yard
13th April 1842

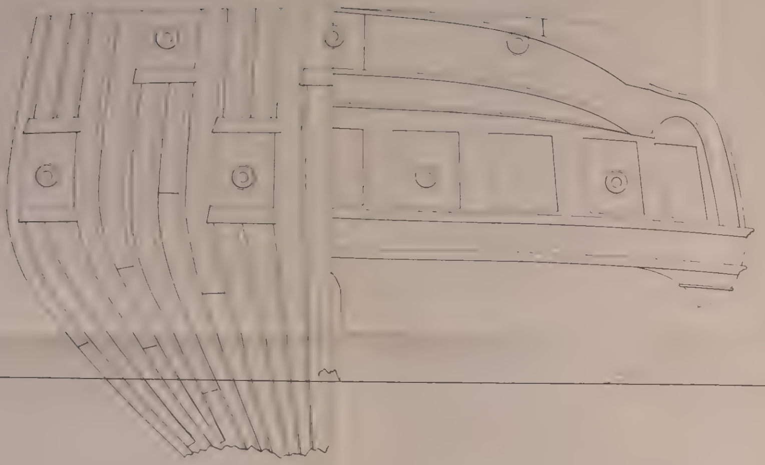
A PLAN OF STERN FOR LARGE FRIGATES, propos the COMMITTEE OF MASTER SHIPWRIGHTS,

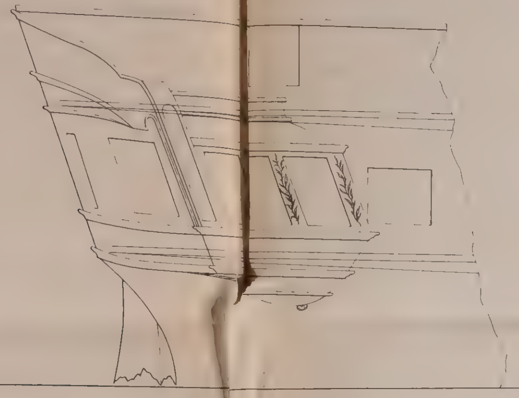
In pursuance of Admir der of 23rd December 1841.

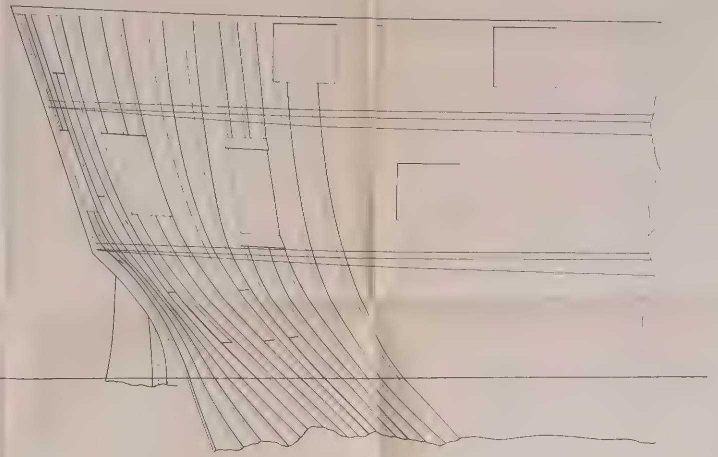
No. 9.

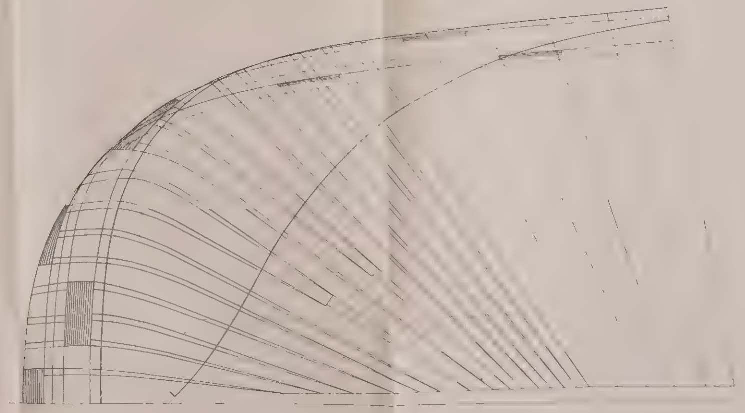
It will be seen by the Plans that 7 Guns can be pointed in a line with the Keel, the whole hich have a proper space between them for their being worked efficiently, and will crofs fire with each other, and the after Broadside by which every point can be fully defended.

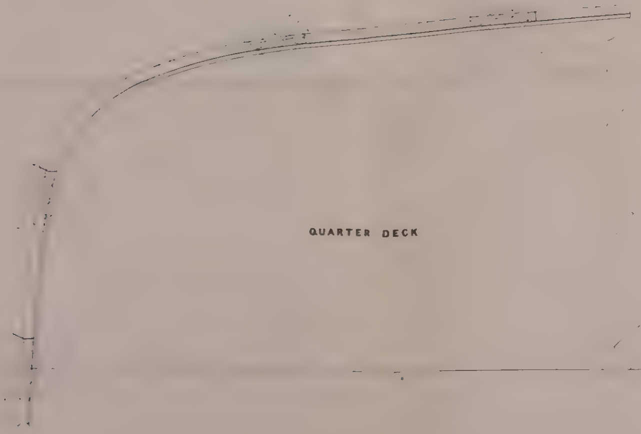
O Lang Hawkes J. Blake J. Atkins.

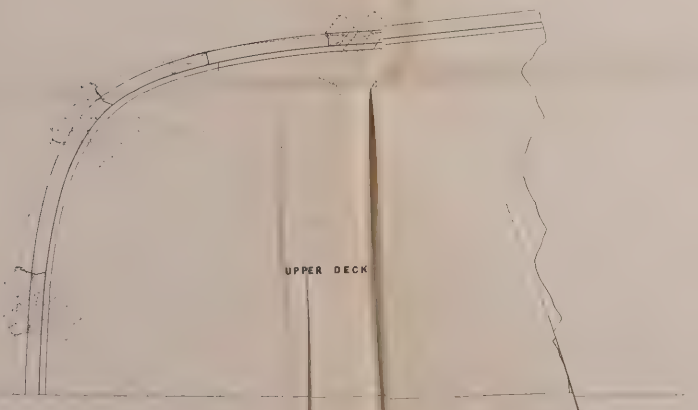


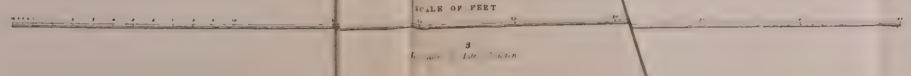




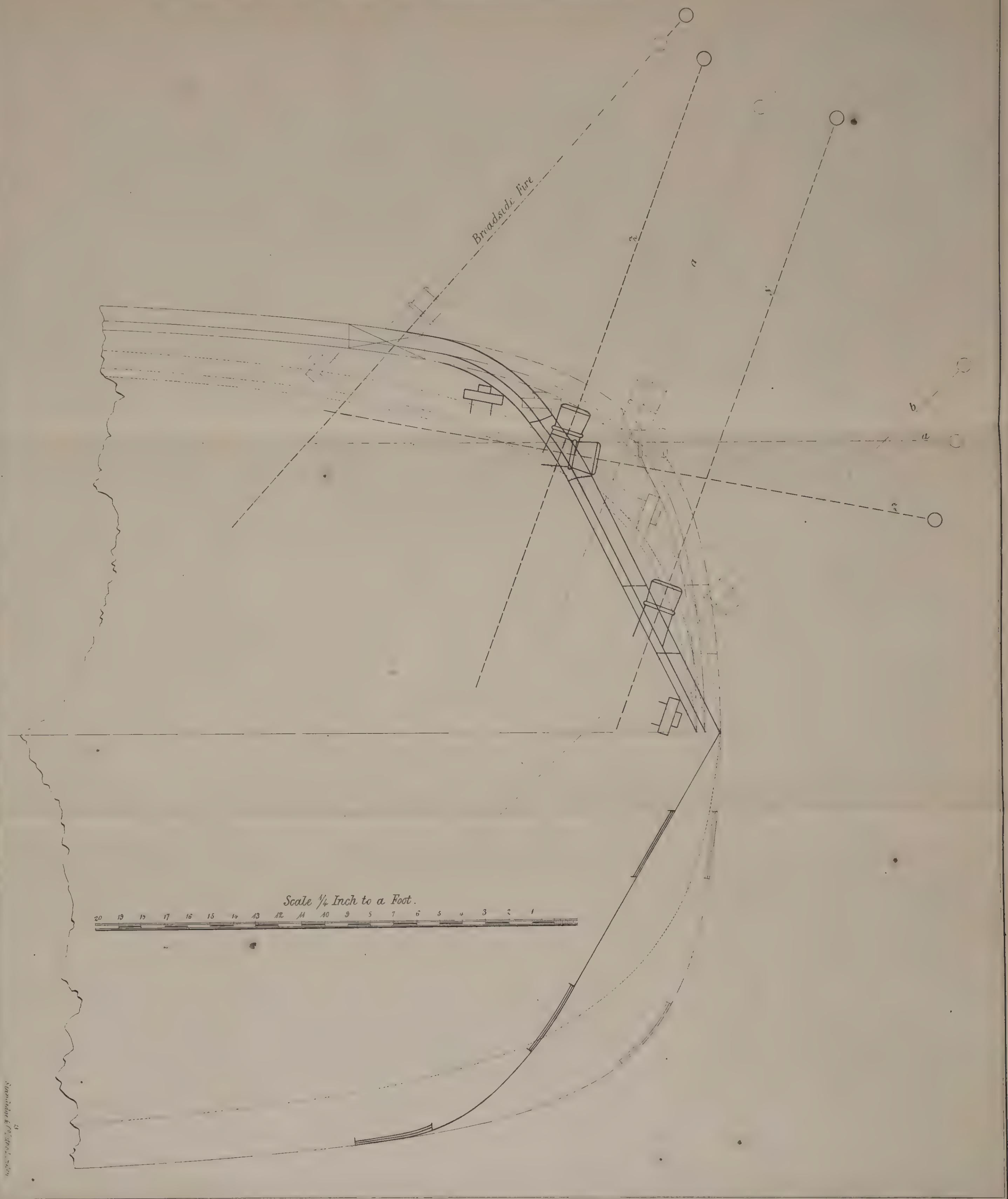








Sketch of the Outline of the Forecastle of the Powerful, distinguished by dotted lines. — also in thin lines the Form proposed by the Committee, and in thick lines the Form suggested by Mr Blake in conformity to what was practised on the Vindictive



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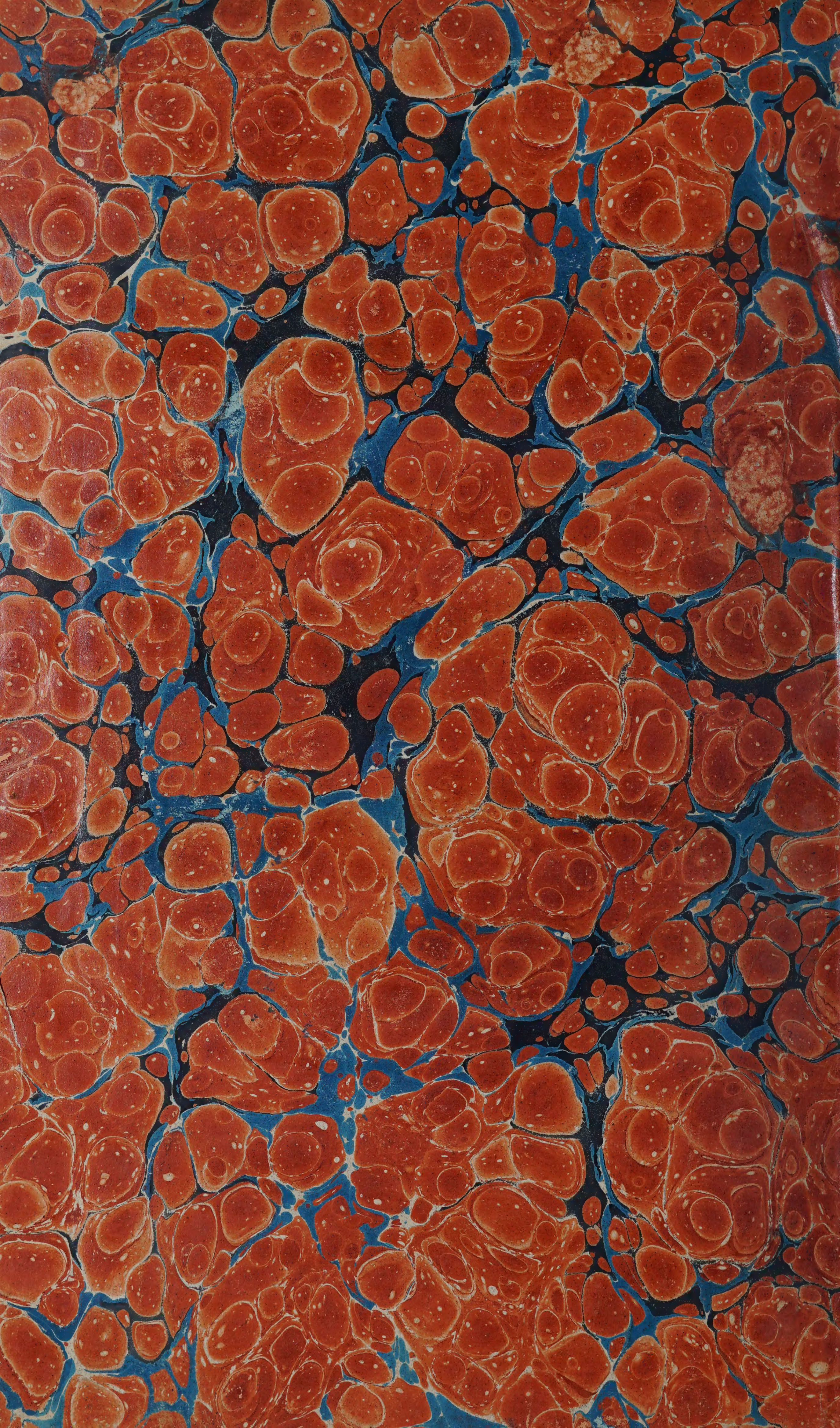

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